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ROLE OF CHEMISTRY IN OBSTETRICS AND GYNECOLOGY*

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ONE of the characteristics of man is to become so engrossed in one task, one field of labor or one specialty, be it in any profession or trade, as never to develop, or perhaps to lose interest in any other sphere of work, even if such be related to his own activities. That this statement holds true for the medical profession cannot be denied. In our own specialty we encounter it daily. The busy gynecologist and obstetrician has not the time and unfortunately seldom the inclination to acquaint himself with the daily happenings in the fundamental sciences related to his specialty. He often scarcely appreciates what his specialty owes to the contributions from the pure sciences.

A further common trait of man is that his taste so often depends on cultivation or education. One cannot intelligently appreciate, much less enjoy the beautiful revelations in any science unless one be schooled in that science. How many of us try to obtain an intelligent appreciation of the recent contributions in chemistry, physics and mathematics as applied to the constitution and properties of the proton and electron, and fail miserably! It is not our fault. Life unfortunately is too short for any of us to be properly schooled in all the sciences. The most we can hope to acquire is a thorough knowledge of one, and a few of us perhaps of two subjects, together with just enough knowledge of another subject to appreciate and occasionally apply its contributions to our own subject or specialty. It takes half the span of our life, or longer, to master completely any one of the sciences, unless we belong to that small group labeled "genius."

These facts, are the reasons for the slow progress of medicine through the ages. The pure scientist can seldom apply his knowledge to the understanding of disease unless he also be trained in that field. Similarly the clinician or surgeon, knowing full well what he wants to discover, seldom has the necessary scientific training to know how to proceed.

The picture I have here painted is a rather gloomy one. Fortunately, however, there have appeared, although sometimes at only long intervals, men and women endowed with the spirit and will to overcome those obstacles. To these medicine owes a debt which cannot be paid.

I wish to point out a few of the debts our specialty owes to the science of chemistry. Although I am not properly equipped to follow and grasp the full significance of the secrets that are constantly being revealed in that all-fundamental science,

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I shall endeavor to review a few of its recent contributions to gynecology and obstetrics.

It is safe to state that our specialty could have made little or no progress during the past few decades without the aid of chemistry. Even the earliest advances often owe their very existence to that science. I need only draw your attention to the discovery of general anesthesia. There is certainly no discovery in medicine which has been more conducive to the advance of all branches of medicine than the discovery of general anesthesia. The medical sciences, physiology, pharmacology, pathology and bacteriology would have remained inaccurate and incomplete hand-maidens of medicine, had it not been made possible by the aid of anesthesia to critically examine, corroborate or disprove the claims, hypotheses and tenets of workers of all types.

The discovery of general anesthesia rests mainly on the discovery of oxygen. It was Humphrey Davy in the latter part of the 18th century, working as an assistant to Beddoés, who tested gases on himself, and found the anesthetic properties of nitrous oxide (N_2O). He wrote: "As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used to advantage during surgical operations in which no great effusion of blood takes place." Davy certainly could never have dreamed the advances in medicine that were to follow as a result of this statement. Following this discovery volatile substances of various kinds were soon the subject of experimentation. Ether was one of these substances, and it was soon known to experimenters that this chemical produced an exhilarating effect. It was the "ether frolic" known to Long of Georgia, which made him experiment with it in surgery. The result is common knowledge.

Anesthesia ranks with asepsis in surgery. The advances in gynecological operations are too well known to you for me to relate; but do we appreciate fully how these advances were made possible by the work of the chemist?

In the early history of the development of our specialty we find innumerable examples of the aid of chemistry, but as I wish to limit my remarks to the more recent advances I will remind you only of the work of Lever. His discovery of albuminuria, by a simple chemical test, started our knowledge of the toxemias of pregnancy.

Although the recent chemical discoveries in obstetrics and gynecology represent only the beginning of a long and arduous task which will ultimately reveal the cause and effect of diseases common to womankind, they already astound the interested student. It should be said here that the advance of medicine does not depend so much on spectacular discoveries as on the process of adding knowledge stone upon stone.

In all medicine there is no greater example of a metabolic upheaval affecting most, if not all, of the organism as is seen in what we term a normal pregnancy. Furthermore, these changes are all consistent with normal life. The knowledge of these maternal changes during pregnancy has been acquired almost exclusively through the aid of chemistry. A host of workers, some of whom have labored prodigiously, have been responsible for assembling this knowledge.

Imagine, if you will, a woman going about her usual household duties with her heart working continuously approximately 35 per cent above normal, an increase of her blood volume, an increase of her basal metabolic rate, amounting to about 17 per cent, a disturbance of her nitrogen balance, being negative during the first half and positive during the second half of pregnancy, with a relative change in the percentages of her blood proteins, with a change in moisture content of her blood, with a relative decrease in her urea nitrogen excretion, with an increase in total lipoids in her blood amounting to almost 100 per cent, with a marked

tendency to acetonuria and with a reduction in total base in her blood of 8 milleequivalents or about 5 per cent. We cannot conceive of such changes, present simultaneously, and consistent with life, in any other condition. We have learned of all of these metabolic changes through the methods and tools of the chemist. Today we regard the normal pregnant woman from a metabolic standpoint as wholly different from her non-pregnant sister. It is inconceivable that a person can function normally with a total base reduction of 5 per cent. Such a change is indicative of a profound upset in acid-base equilibrium and not seen in health. Yet chemistry has shown us that it is a normal finding in a pregnant woman at term. The same may be said of the other metabolic changes enumerated. Chemistry has shown us the existence of these profound changes, and it is on chemistry that we must depend for a solution of the cause and effect of these marked divergences from the non-pregnant normal. We are just at the beginning of an intelligent study of our specialty.

Through the clinical investigations of Slemons, Plass, and others we have a fairly accurate, although not yet complete, understanding of the nutrition of the fetus. We are beginning to be able to link up some of the marked metabolic changes in the mother with the nutrition of her child. We know that the child uses mainly carbohydrates and protein, which it obtains directly from the mother, while it undoubtedly manufactures its own fats out of these. At the time of birth its energy requirements come wholly from carbohydrates, its respiratory quotient being unity. Furthermore, we are gradually gaining information regarding its requirements and metabolism of the inorganic elements. We know that such elements as calcium and iron must be supplied to it in definite forms and amounts, and we also know the limitations of the maternal organism in this respect. This is already a marvelous understanding, although as yet so incomplete, of the beginning of life, and all due to the application of chemistry to obstetrics. The nutrition of the human fetus reminds us of that most fundamental work of Jacques Loeb, where he demonstrated, in a series of now famous experiments, that the development of the egg of the sea-urchin could be started by chemicals added to water bathing the eggs. Jacques Loeb, as Julius Stieglitz puts it, connected life at its threshold with chemical activity. Similar experiments have been carried out with the eggs of frogs where the eggs under the influence of chemicals have been carried to the development of frogs. To understand the growth of the fertilized human ovum, a single small cell, we must understand the chemistry involved in that cell's nourishment obtained from the mother, and the transformation of this nourishment in the chemical laboratory of that growing and multiplying cell. The cell absorbs and secretes chemicals, such as carbohydrates, fats, proteins, minerals and water, and transforms these into complex substances necessary to the life of the organism; it also provides for the oxidation of the foodstuffs, sugar, fat and protein, so necessary to heat and energy production, and lastly it excretes the waste or end-products of metabolism. It is only through chemistry that we are beginning to understand the very processes of life.

We have seen the vital role chemistry has played in revealing the astounding changes in the metabolism of the cells of the maternal organisms during a normal gestation and we have also glanced at its role as displayed in the nourishment of the product of conception. But now let us turn to consider what chemistry has accomplished in explaining the most baffling of the complications of gravidity.

You are all acquainted with the importance of the toxemias of pregnancy. The progress that has been made towards an ultimate correct understanding as to the underlying etiological factors has been

largely due to the aid which chemistry has bestowed on us; and there is no doubt in my mind that all further progress depends on further help from that science.

Although the initial cause of vomiting of pregnancy has not been clearly and definitely enunciated, we already know the changes in the organism as a result of this affliction. Chemistry has explained to us how the H_2O molecule follows the sodium ion, and how loss of water, a decrease in blood chlorides, an increase in blood uric acid and a decrease in blood bicarbonate may result from vomiting. The brilliant work of Mann on liver function has shown us why uric acid increases and sugar decreases in the blood stream when some or all of the liver cells are injured. His clear exposition of the carbohydrate and purine metabolism, during liver damage has helped us immeasurably in understanding the clinical picture resulting from continued vomiting. He has, furthermore, given us a rational basis for the use of carbohydrates in the treatment of any condition associated with liver damage. It was here in Canada, that Harding and Duncan first suggested increased carbohydrate feeding in patients suffering from vomiting of pregnancy; and we have now found through the aid of chemistry in the hands of investigators such as Frank Mann, the rational explanation for that idea advanced fifteen years ago.

A second serious complication of pregnancy is that disease first studied by the Englishman, Bright. I need not tell you of the suffering and deaths resulting from this disease. Unfortunately when accompanied by a pregnancy, it is greatly exacerbated, with the result that the individual's expectancy of life is greatly shortened. Our only hope to combat this dreaded association of nephritis and pregnancy, through which the forces for harm are so augmented, is to discover the disease early and prevent the association's occurrence or continuance. In the greater majority of cases it is only by means of chemical tests that this can be accomplished. It was through that great American pharmacologist, whose work has been wholly along chemical lines, John J. Abel, and his associates, that we began to understand kidney function. His associates, Rowntree and Geraghty, developed the well-known phenolsulphonephthalein test for evaluating renal capacity. This test has been modified in recent years and has been greatly aided by other and more sensitive tests. That great benefactor to medicine, the biochemist of the Rockefeller Institute, D. D. Van Slyke, and his co-workers have given us the urea clearance test, perhaps the most sensitive indicator of renal function. Another chemist and also clinician, Ralph Major, has devised the creatinine excretion test, while a Canadian chemist, Rabinowitz, has shown the value of the urea excretion factor in kidney disease. With the tests now available, through the ingenuity and skill of these chemists, we are able, if we wish to take the time and spend the effort, to recognize most of the mild, early or beginning nephritides which may occur in our patients. I repeat, it is only by the recognition of these early cases that we may hope to be of any real service to these patients. It is needless for me to tell you that in the severer forms of nephritis, the gravity of the condition can be evaluated by chemical means. An analysis of the patient's blood, revealing a nitrogenous retention is, of course, conclusive proof of the inability of the kidneys to excrete the waste products of metabolism. The numerous functions of the kidney, as so beautifully discovered by such pharmacologists and chemists as Marshall and Richards, are wholly chemical. It must be clear then, that in order to properly understand and treat any disease which alters these functions, we must appreciate and know the clinical processes involved in each individual case. No study of a nephritic patient is complete or satisfactory without the aid of the chemical laboratory, and consequently,

no treatment can be rational without this aid. Chemistry has already assisted us beyond measure in recognizing, understanding, evaluating and treating nephritis occurring during pregnancy and I have full confidence that it will take us to our goal in our fight against this disease.

We now come to the third and perhaps most intriguing of the toxemias of pregnancy, eclampsia and its fore-runner pre-eclampsia. Eclampsia has been called the disease of theories, mainly because most of the investigations, on which these theories were based, were not conducted along strictly scientific lines. Science is accurate and truthful. The application of scientific methods have disproved most of the numerous theories advanced. It will be by a gradual accumulation of scientific data relating to this disease that we will ultimately accurately understand its etiology and so be able to prevent or treat it rationally. Chemistry has shown us the many pitfalls of earlier investigations. It has revealed the few indisputable facts today known about the disease. There can be no doubt in the minds of any of you that the disease is accompanied by an increase in uric acid in the blood stream resulting perhaps from liver damage, and by a compensated and sometimes an uncompensated or true acidosis; and that nitrogenous retention, as represented by an elevated blood non-protein and urea nitrogen, if present, is a later occurrence and certainly plays no role in the initiation of the disease. Although often not appreciated, these are salient facts, for they have shown the disease to be different from nephritis and have explained the cause of death, occurring in certain patients within an hour or two following the first convulsion. There is no doubt in my mind that an eclamptic patient cannot survive many minutes with an uncompensated acidosis, the hydrogen-ion concentration in her blood being represented by a pH of, say, 7.00. Chemistry has shown that in a few unfortunate women the eclampsia may result in such a disturbance of acid-base equilibrium and it is thus only by the recognition of this state of affairs together with appropriate anti-acidosis treatment that such patients may be saved.

There is perhaps in the minds of some of you the thought that certain of the published chemical data relating to eclampsia have been of a conflicting nature. I have reference to values reported for blood calcium, blood serum proteins and blood sugars. As already stated, chemistry itself is accurate and truthful, although some of the methods employed to elicit chemical data are as yet not perfect. The biochemists, Benedict, Folin, Van Slyke and others, to whom we owe so much, are constantly laboring to improve methods for quantitative analysis of blood, urine and body fluid. Certain of our methods are of the microchemical type and require special training and skill on the part of the analyst. From my point of view, it is only inevitable that there should be a certain amount of conflicting data in the literature. This does not mean that the chemist is at fault, it rather means that some of his methods of analysis require further improvement, so that conflicting and rival ideas may be accurately examined. This has been the essence of chemical progress and this is why thousands of chemists are daily working on improved and new methods of analysis. If this were not so the spirit of progress and advance in our most fundamental science would die. The only interest of the chemist is to find the truth. His interest is not to accumulate a mass of data to fit or explain his own ideas or theories. His ideas and theories follow the completion of his work. There can be no doubt that as chemistry, through its faithful and numerous workers, gives us more information regarding the methods of analysis, the few conflicting ideas will vanish and we will be nearer a final solution of the problem of the etiology of eclampsia. We already know that a decreased and low blood calcium, as formerly believed,

cannot explain the causation of that disease. Newer and improved analytical chemical methods have made this possible. So also in the field of serum protein investigation. Recent contributions in this sphere of chemistry are beginning to furnish reliable data. Lastly, the field of carbohydrate metabolism is so complex that we must await further aid from the chemist before we can have a final understanding. The blood sugar gives us information at only one link in the chain of carbohydrate metabolism. The level of blood sugar is dependent on so many factors, such as muscular activity, the rate of cell oxidation, the elimination, as well as conversion, of lactic acid, the supply of glycogen, the ketogenic and antiketogenic factors, and perhaps other factors yet to be divulged by the chemist, that it would be hazardous for me to venture any definite statement as to carbohydrate metabolism in eclampsia. There can be no question, however, that chemistry will ultimately show us the complete carbohydrate chain. One is constantly impressed by the stupendous amount of work in this field, as seen by the contributions appearing in the current chemical journals.

Valuable chemical data have already been obtained in the fat, protein and mineral metabolism in eclampsia; but here also the information is still incomplete. The cause of eclampsia will not be discovered by one person, using only his own investigations. It will be discovered after we have completely erected the structure built on a vast number of facts, shown one by one through the aid of chemistry. This has also been the story in diabetes and insulin. The chemical work covered a century of painstaking investigations, until finally several investigators were on the brink of that epoch-making discovery. No one person can be given all the credit for this work. But, then, science does not look for credit but for its own truths, from which come the greatest benefits to mankind. It is, indeed, to chemistry that we must turn our hopes for the ultimate understanding of this dreaded disease, eclampsia.

The anemias, as well as loss of blood by hemorrhage, are further subjects of concern to the obstetrician and gynecologist. The chemistry of cell oxidation and hemoglobin has been almost completely solved. We are nearing the solution of the several anemias through the magnificent work of the past ten years by such investigators as Whipple and Minot and many others. We are gradually but steadily beginning to understand the chemical processes involved in anemia and hemorrhage and so are enabled to prevent or treat these conditions in an understanding manner.

In the field of gynecology, local anesthesia and instillation anesthesias, such as avertin, are beginning to play a larger and larger role. Ether had been known for centuries, nitrous oxide was discovered by Priestly in 1776 and chloroform by Guthrie in 1831, and these substances were introduced into surgery between the years 1844 and 1847. Although the alkaloid cocaine was isolated as early as 1860 it was not until 1884 that Koller made the first real application of this drug in eye surgery. Synthetic chemistry has produced numerous local anesthetics better than the alkaloid cocaine. Warren writes:

> A new era has opened to the operating surgeons! His visitations on the most delicate parts are performed, not only without agonizing screams he has been accustomed to hear, but sometimes with a state of perfect insensibility, and occasionally even with the expression of pleasure on the part of the patient. Who could have imagined that drawing the knife over the delicate skin of the face might produce a sensation of unmixed delight! That the turning and twisting of instruments in the most sensitive bladder might be accompanied by a beautiful dream!

Not only gynecology, but also its sister, obstetrics, has benefited richly from the recent advances in local anesthesia and analgesia. We are steadily approaching

the solution of a perfect analgesia for labor. The many valuable chemical contributions in the form of synthetic substances producing varying degrees of analgesia are known to all of you.

I have reserved till now all reference to that all-important and fascinating subject, the endocrine glands, effecting so vitally gynecology and obstetrics alike. We are today truly living in an endocrine era. The secrets divulged by the physiological and chemical study of these glands have left us amazed. All this has come about during the past ten years. The chemical isolation work of Allen and Doisy, the investigations of Evans and Long, Smith and Engel, Hartman and his co-workers, Frank, Novak and others need no repetition in this audience. Last year, Evans of California, that brilliant worker in this field, spent his time in the chemical laboratories of the Rockefeller Institute in New York in order to further this work. Without the chemist and his methods of investigation and analysis, the functions and interfunctions of the endocrine glands can never be understood. This subject is too stupendous for me to outline all the recent fundamental contributions, and I must content myself by stating that we are beginning to understand the causes of menorrhagia, metrorrhagia, amenorrhea, dysfunction of one or several of the endocrine glands and many of the heretofore inexplicable affections of womankind as a result of the application of chemistry to this part of our specialty.

I have not touched upon the application of chemical tests for liver or gall-bladder function. Nor have I referred to the chemical isolation of epinephrine or the principle of the pituitary and their application to our specialty, to the use of such chemical preparations as ergot, gynergen, and a vast array of others, many of which have come forth only recently from the chemical laboratory. Chemistry touches the daily work of the obstetrician and gynecologists at so many points that it is an impossible task to present a complete review.

In conclusion, it must be clear to you who have listened to this brief recital of certain of the accomplishments of chemistry in the field of obstetrics and gynecology, that our fondest hopes for an ultimate solution of the many unsolved problems in this field must rest upon the slow but steady accumulation of chemical truths as divulged by the painstaking and careful investigator, imbued with the spirit to see and understand the secrets of nature.

Chemistry is the fundamental science dealing with the transformation of matter. Life from its beginning to its end is wholly dependent upon the complex transformation of matter. We can have no understanding of any disease without a knowledge of the chemical processes involved, and so we can have no rational cure or treatment without this knowledge.

I wish to leave with you a plea to use your influence, wherever possible, to direct the destinies of the young pre-medical or medical student so that when he has completed his education and training, he be properly equipped to overcome that human tendency to become all-absorbed in the small and narrow sphere of his daily work. We are in dire need of gynecologists and obstetricians trained in one or other of the fundamental sciences, even if only to the extent of being able to exercise an intelligent appreciation of that science. The onward march of our specialty depends on men and women so trained.

A PLEA FOR

CONSCIENTIOUS PRENATAL CARE*

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PRENATAL care has been given considerable attention in the literature during the last several years. However, no portion of medicine is more neglected than the care of the expectant mother. Because of old traditions and superstitions, our immediate ancestors sought the services of the physician probably a month before the expected delivery, just to let the doctor know that he might expect a call. Examination of the patient, if the physician arrived before the delivery, was done first and last, when the stork was on the way. In this sort of practice there were many complications that often became tragedies.

In modern communities the situation has markedly improved, and in recent years the mortality rate has been greatly decreased. However, the first eleven months of 1933, Kansas lost 139 mothers in 27,526 deliveries. This number of deaths is appalling when one stops to consider that most of the cases were handled by licensed physicians, who are supposed to be well trained, and to practice aseptic conservatism.

The situation is not local. In 1930, the New York Academy of Medicine organized a committee to study maternal mortality in New York City. In the three years, 1930, 1931, and 1932, there were 2041 maternal deaths in New York. Of this number, the committee estimated that 1343 or 65 per cent would have been preventable, if the women had been given proper care during pregnancy and labor.

On the other hand it is quite gratifying to the obstetrician, to read statistics from the Chicago Lying-In Hospital, reporting 23,136 deliveries with only 57 deaths, and part of these were cases that had been mis-managed before the patient entered the hospital for delivery. Prenatal care is routine in this hospital.

Since medicine has made such definite advances in other fields, it is high time that all medical societies demand better obstetrics in their own communities. This can be done by every physician, whether oculist or pediatrician, urging that their patient seek competent obstetrical care.

Prenatal care should begin as soon as a positive diagnosis of pregnancy has been made. At the first visit a careful history, and physical examination should be made. It is important to know something of the family history. Are there any cases of tuberculosis, nephritis, syphilis, or bleeders in the family? Has the patient's mother or sister had any abnormal pregnancies or labors, and why? In her personal history do not overlook the diseases of childhood, that may have left chronic heart or kidney disease. The history of any nervous disorders and the patient's reaction to physical stress and worry may be of great value to the physician in assisting the patient to adjust herself to the pregnancy and prevent an impending psychosis. Do not fail to inquire about chronic infections, for many a case of pyelitis has been caused by an infected tooth. If a focal infection is discovered, insist that it be cleared up as soon as possible. If there has been a former pregnancy, a detailed history should be elicited for often symptoms that may be passed over lightly by the patient may have

* Read before the Sedgwick County Medical Society.

an important bearing on a succeeding pregnancy and labor. If there has been a difficult labor or a stillbirth, the exact cause should be determined and the case discussed with the patient. Many of these experiences can be explained to the patient so as to prevent any psychic reaction, and restore her morale.

The physical examination should be complete, and thorough. Every case should have a complete urinalysis, blood count, and a Wassermann test. A basal metabolism, and other laboratory work will often explain puzzling symptoms, and will be useful in prognosticating the patient's future health.

The examination is not complete without measuring the pelvis, and examining its contents. Is the uterus in position, and movable? Is it enlarged to correspond to the length of estimated pregnancy? If it is retrodisplaced, can it be brought up into position and kept there? Fibroids and ovarian tumors must be sought for, and if found, great care must be exercised in determining how their size and position may affect the progress of the pregnancy and labor. Many men of wide experience advocate early removal of ovarian tumors found in pregnancy, feeling that an operation is less dangerous than the risk of the tumor enlarging, or becoming twisted during gestation.

In doing the bimanual examination, if the index finger of the average hand touches the promontory of the sacrum, the pelvis is contracted or flat. If the tip of the middle finger touches the promontory, a fetal head of average size may be expected to deliver through the pelvis. The closer the intraspinous measurement approaches the intracrestal measurement, or the wider the rhomboid of Michaelis, the flatter the pelvis is likely to be. Look also for the dystrophia dystocia syndrome described by Drs. Horner and DeLee. There is a disproportional shortening of the bones of the extremities. If the ordinary hand can span the ulna, one is sure of a contracted pelvis, a slow dilating time, and a hard labor.

After a careful correlation of the findings, have a frank discussion with the patient in regards to any variation from the normal, and outline the prenatal care. This does not mean that the patient should be worried with a great many details, but it does improve your standing with the family, and yourself, to be fore-armed when pathology develops. If certain pathological conditions are present that the physician is not capable of treating, the patient should be referred to a specialist for further treatment. The general practitioner may take exception to this statement, but if he is not capable to care for infected tonsils, or cardiac lesions, he should not jeopardize his patient's life by ignoring her condition.

Insist on regular office visits, so that the weight, blood pressure, and urinalysis may be carefully charted. The diet need be changed very little. Allow food which the patient likes, because taste promotes digestion. The average pregnant women gets along on 1200 to 1500 calories a day. The patient should not be allowed to gain over 20 pounds during the pregnancy. If overweight at the beginning of pregnancy, many cases can be carried through the nine months without gaining. The records of many cases show that a sudden increase in weight is immediately followed by a sharp rise in blood pressure, albuminuria, and later pre-eclamptic toxemia develops.

The patient should bring a 2 ounce specimen of urine at each visit. A morning specimen is preferable, because the urine is concentrated. A monthly twenty-four hour sample is an excellent index to how the kidneys are responding to the pregnancy. Many cases of toxemia or incipient pyelitis have been prevented by instituting therapy at the first indication of pathologic urine.

Regular blood pressure readings will also give us information of great value, especially when evaluated with our other findings. A systolic pressure of 130–140 early in the pregnancy nearly always means a chronic nephritis, and should be a warn-

ing to put the patient on a careful regime. Many patients can be carried successfully to term, if they will cooperate. Most authorities feel that a blood pressure of 150 mm. at the beginning of pregnancy is enough indication to terminate the pregnancy.

The patient should be instructed to have a bowel movement at least once a day. Plenty of fluid, coarse vegetables, fruits, and exercise are the best method of handling the bowels. If necessary a tablespoonful of mineral oil or a mild laxative may be given after each meal to make a more normal movement. By regular copious evacuation the tendency to toxemia, hemorrhoids, varicosities, and general malaise is greatly lessened.

The patient should be advised to exercise a moderate amount every day in the sun. The amount of exercise depends on the character of exercise the patient has been accustomed to before pregnancy. The principal thing is to avoid exhaustion. Violent exercise such as tennis or riding is to be avoided. Bathing, swimming, golf and other forms of light exercise may be indulged in during the first six months. Ordinary housework may be done up to the onset of labor. It not only affords exercise but keeps the mind occupied.

The dress should be simple and protective. Tight clothes and girdles are to be condemned. Round garters have a tendency to produce varicosities, and should be replaced by garter belts. The shoes should be of low-heeled oxford type so that the patient may walk with ease, and preserve the proper posture. Many pregnant women are unnecessarily uncomfortable from pressure and weight of the gravid uterus. Nearly all of these conditions may be improved by wearing a properly applied maternity corset, which not only gives relief from the sagging pendulous abdomen, but also helps to prevent faulty position by holding the head directly over the inlet. It is surprising to see how many women with low backache, hip-ache, inability to be on the feet long at a time, edema, and varicosities are almost immediately relieved or cured by adjusting an improperly fitted corset; or the application of a simple muslin binder with shoulder straps. Likewise the painful engorged breasts of the first trimester are entirely and quickly relieved by a properly fitted uplift brassiere.

Many cases of nausea and vomiting need only a regulation of the diet. Removal of all fats and spices with an increase in the carbohydrate intake usually works like magic. Usually three meals a day are not sufficient to keep the patient from having the characteristic "empty feeling." A few salty crackers, cookies or a glass of milk taken at about ten and three o'clock and again at bedtime will soon relieve this sensation and prevent nausea. For the early morning sickness, have the husband get the patient a cup of hot water, and a plate of salty crackers. These should be eaten in bed. The patient should then lie on the right side for twenty minutes before getting up, then eat the regular breakfast. It may be necessary for some one else to cook the breakfast, for often the odor of food cooking is responsible for the nausea. Most of these cases occur in neurotic women. These women become pregnant, and cannot adjust themselves to their environment. The vomiting is considered to be a very important symptom of pregnancy to these people, and calls for much sympathy. Nausea and vomiting are considered an early toxemia. Persistent vomiting is a serious condition. A patient who vomits day after day becomes exhausted from vomiting, the inability to retain foods and fluids, and from lack of sleep. If the process goes on we soon have dehydration, acidosis, and even acute yellow atrophy of the liver.

It is very difficult to tell in advance just how to manage these cases. The etiology should be sought for and removed. If a malposition is present correct it, and have the patient take the knee-chest position four times a day. It may be necessary to use a pessary until the uterus has enlarged, and is out of the pelvis. Sexual intercourse

is a frequent cause of reflex vomiting, and should be prohibited during the first three months of gestation.

The management of these cases is symptomatic. Exhaustion is prevented by using sedatives in rather large doses. Sodium bromide is extensively used, and is quite satisfactory in doses of 15 and 20 grains, three times a day. In severe cases, the dosage of bromide may be increased for two or three days. The patient must be carefully watched for toxic symptoms of bromide poisoning. If the bromides are not tolerated orally, a retention enema of sodium bromide in 5 per cent glucose is often effective. A very useful gastric sedative is a capsule containing veronal gr. ii and bismuth subnitrate gr. xv. Some of the new barbiturate preparations are giving excellent results in preventing nausea. Dehydration and acidosis are prevented by hypodermoclysis of saline solution, or 500 c.c. of 5 per cent glucose in the vein. In certain cases of low blood pressure, adrenalin chloride, 10 drops three times a day, will raise the pressure to normal and prevent nausea. Falls has had excellent results with Lugol's solution especially in cases of hyperthyroidism. In certain cases the sex hormone is low, and one ampoule of corpus luteum every forty-eight hours will relieve the nausea until the placenta is able to secrete the required amount of the hormone. Psychotherapy plays an important role in the treatment, but one should not neglect the patient's physical condition. These cases tax the physician's skill and judgment. When the pregnancy should be terminated depends upon the resistance of the patient. Such symptoms as jaundice, hemorrhage, hematuria, coffee vomitus, low blood pressure, and a fast pulse should demand consultation, and a therapeutic abortion.

The pathology of pregnancy covers too large a scope to be discussed in this paper. In ideal prenatal care it is hoped to prevent pathology. By carefully watching the patient, abnormal conditions can be detected early, and therapy instituted that will give the patient a far better chance of going to term and through labor, than if her progress is left to nature.

CONCLUSION AND SUMMARY

In spite of improved prenatal care, reliable statistics prove that the maternal mortality rate has not been decreased, because the good work of the trained and skilled physician is overbalanced by the poor work of the unskilled and unconscientious practitioner.

It is the duty of every physician to help improve the maternal mortality rate by educating the laity to demand better obstetrics.

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POSTPARTUM PYELITIS OF PREGNANCY

TREATMENT OF CERTAIN CASES WITHOUT THE USE OF THE URETERAL CATHETER AN EXPLANATION BASED ON THE PHYSIOLOGY OF THE BLADDER

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In this consideration of postpartum pyelitis[1] it is desirable to stress the point that bladder catheterization is only done in those cases which show a marked toxicity or dysuria or both. The urethral catheter, in all instances of urinary stasis *without infection* is undesirable but permissable if there is marked dysuria or discomfort. It should only be used providing the bladder infection, which it may cause, is managed in the manner of surgical infections requiring drainage, that is, drainage must be ample and continuous until the time arrives when the bladder can satisfactorily supply this drainage by its own perfect function.

It is my opinion that, as a rule with but few exceptions, in an *uninfected postpartum incomplete retention* it is unwise and unnecessary to catheterize because, as I shall point out, sensation to overdistention is diminished in these cases and the dysfunction is not corrected by the catheterization. On the other hand, in an uninfected *postoperative* incomplete bladder retention, it is often wise and necessary to catheterize because sensation is not diminished in these cases and, as a result of catheterization, normal bladder function is usually instituted inside of three days at the most and frequently with one or two catheterizations.

THE POSTOPERATIVE BLADDER

I wish to explain this differentiation and to consider briefly the postoperative bladder only to lay it aside in favor of a more complete consideration of the postpartum retention bladder. The postoperative retention bladder is initiated by a reflex inhibition of the bladder wall which occurs immediately with the operation. This permits an increase in the capacity of the bladder to such a point that the wall is thinned beyond the thickness essential for the necessary strength to cause expulsion of urine through a normal outlet.[2] Emptying this bladder by one catheterization causes a contraction and thickening of its wall thereby giving it more expulsive strength. Practically always normal voiding starts with one to four catheterizations. When it does not, it means that there is continued inhibition, reflex from the operative area. In one such case studied cystometrically the retention persisted for eight weeks. Otherwise, postoperative retention may be due to the patient's position in bed, simple overdistention caused by a large fluid intake such as subcutaneous or intravenous fluids while still under the influence of scopolamine, ether, morphine, etc., refusal of the patient to cause himself pain by contracting the belly wall or perineal muscles necessary to the act of voiding. The postoperative retention bladder is, therefore, *characterized by a large capacity associated with the pain of overdistention and low intracystic pressure.*

It is necessary to consider the postoperative bladder because it may be caused by the trauma of delivery or by an episiotomy and so we may have, in postpartum urinary retention, any degree of the postoperative type of retention associated.

In postpartum bladder retention we have diminished sensation to increased intracystic pressure. This pressure change, which is not always present but only during stimulation of the wall of the bladder, is caused by a distinctly increased resistance

of the bladder wall to distention, and this transient neurogenic phase (relative anesthesia) occurs as the result of long-continued or unusually severe compression of the pudic nerve (a temporary physiological nerve block) applied to that portion of it which travels the inner surface of the tuberosity of the ischium and also to its termination in and about the urethra. Disproportion between the size of the pelvic outlet and the child's head during the second stage of labor furnishes the requisite for this nerve compression. I believe that the pudic nerve transmits the urethral sensation of a "desire to void." This initial or "first desire to void" sensation in the act of micturation is stimulated by the pressure against the posterior urethra of an involuntary bladder wall contraction which, in turn, has been stimulated by the weight of accumulated urine within the viscus. The motor phase of the pudic nerve reflex has to do with maintaining tone, depressing and opening the external or voluntary bladder sphincter. When, therefore, a postpartum physiological block of the pudic nerve occurs this sphincter becomes a passive obstacle to the expulsive force of the bladder wall. Even the heightened intracystic pressure does not initiate a satisfactory (pudic nerve) external sphincter reflex.

It is back of this relatively anesthetic and sluggish voluntary bladder outlet that the smooth muscle wall with its balanced autonomic innervation becomes altered in an attempt to perform its function of emptying the bladder. As a result of this increased resistance of the outlet, a compensation or muscular thickening of the bladder wall occurs. This change follows the same physiological laws as in any outlet obstruction, hypertrophied prostate for example. Added to the relatively anesthetic, imperfectly functioning voluntary outlet or external sphincter, and the compensated bladder wall, the effect of the months of compression, during pregnancy, of the entire viscus by the large uterus, exerts an effect in reducing the elasticity of the wall of the bladder.

Postpartum bladder retention is, therefore, *characterized by an overdistention without pain with an abnormally high intracystic pressure.*

It is possible to differentiate the two types or at least to determine the predominant type of retention, at the bedside, by filling the bladder with sterile water from a graduated irrigating vessel held about three feet above the level of the abdomen. If the "desire to void" occurs with 200 c.c. or more (even up to 900 c.c. in rare cases) and there is early increased resistance to the filling, by the bladder wall, it points to a postpartum type. The amount of the residual urine should check roughly with the degree of diminished "desire to void" sensation. On the other hand, if the bladder fills readily and the "first desire to void" occurs early in the filling (100 to 200 c.c.) it points to a postoperative type of retention. In this type the amount of the residual urine is large, out of proportion in most cases to any abnormality noted in the filling of the bladder because, we recall, the last stages of the overdistention were made possible by the thinning of a normal bladder musculature.

On this basis I now desire to delineate a treatment rationale applicable to certain cases of postpartum bladder retention. My paper is entitled, "Certain Cases, etc., Without the Use of the Ureteral Catheter," because it is impossible to control all such retentions satisfactorily without the use of such a catheter for, in some, we have definite stasis above, such abnormalities as ureteral strictures, small orifices, periureteritis, contact ureteral pressure, stone, position of the kidney, tortuous and excessive hydroureters, etc.; all of which, associated with a typical postpartum bladder, may require the ureteral catheter to effect the necessary drainage.[3]

In using a retention ureteral catheter it is extremely important that its drainage eyes be placed so that they may drain the entire pelvis equally; particularly those kidneys

with long, narrow major calyces and small true pelves. It is possible for the catheter to extend through this common pelvis and into and through a long major calyx of small diameter, to an upper or lower pole either of which would relatively block the remaining major-minor calyces and so exacerbate the pyelonephritis. Further, if the tip of the catheter be left below the ureteral-pelvic junction peristaltic action may cause its expulsion. To know the type of pelvis by pyelogram is, therefore, of great value in placing a continuous drainage ureteral catheter. A bifid type of pelvis, even though of minor degree, is often quite impossible to drain satisfactorily unless such drainage can be instituted by way of the dilated lower ureter.[3]

Irrigation with such a catheter is best done with sterile water or saline to dilute the infection, keep the catheter open, and facilitate drainage which, after all, is the important thing. Drugs of sufficient strength to cause vasodilatation and exfoliation of superficial protective cells, if used over a long period, may delay healing.

Having determined by methylene blue stain and possibly culture of a freshly catheterized specimen together with the other clinical evidence, that we have to deal with a postpartum pyelo-cystitis, the first step in outlining our treatment is to determine the amount of residual urine present. If this amount is large, and there has been little or no pain of overdistention, the chief symptoms being those of infection, I should feel that the residual urine is of the postpartum type and that the bladder dysfunction will probably continue for a few days at least. The toxicity present is generally recognized as being renal in origin, which it is to a considerable degree. However, the acutely inflamed bladder is very definitely an organ of absorption. Further, it is the chief focus for continued or repeated kidney infections. Consequently, urethral catheter drainage, either intermittent or continuous, is indicated depending upon the degree of urinary infection, and the type and amount of retention and probability of its duration.

In a postpartum bladder with considerable impairment of function an urethral retention catheter with irrigations every eight to twenty-four hours will:

1. Relieve the bladder of its residual urine and reduce the amount of the infection;
2. Decompress the bladder, thereby preventing mucosal trauma either by overdistention or bladder wall spasm;
3. Drain properly any "foreign body" increase in the cystitis produced by the catheter;
4. Facilitate ureteral flow by removing the resistance to it offered by a residual urine in a highly resistant bladder.

The determination of when finally to remove the continuous drainage urethral catheter rests upon the entire disappearance of the residual urine. To this end it is wise to catheterize for residual urine after the first two voidings following the catheter's removal. Any residual urine after a retention catheter of twenty-four to forty-eight hours or more means a very considerable sphincter block remaining because the now long passively contracted bladder wall is strengthened and should be able to remove the residuum. I have, on one occasion, know a postpartum dysfunction to persist for twenty-one days, but the usual duration is from four to eight days.

Final removal of a retention catheter before the disappearance or marked diminution of the residuum would effect an exaggeration of the conditions produced by one "intermittent" catheterization or of those initiated and increased by repeated catheterizations and the use of or non use of irrigations would have but little effect. However, the additions of irritating instillations either for the purpose of antisepsis or as "glycerine" for the purpose of reducing the residuum, would only increase these undesirable factors, namely greater spasticity of the bladder wall plus added trauma in an, as yet, obstructed bladder.

Therefore, should intermittent catheterization be used in a postpartum case with a large residuum, each emptying would raise the intracystic pressure and add trauma to an acutely inflamed and poorly drained or physiologically blocked bladder. Such a combination, particularly in a bladder with an increased intracystic pressure, would tend to produce reinfection of the kidney via the ureteral lumen, periureteral lymphatics, or bladder lymph or blood channels. The cystoscope, with ureteral catheterization, acts as an intermittent urethral catheter plus increasing the force of ureteral peristalsis by decreasing its retention and, by trauma, opening new avenues of absorption in the ureteral mucosa. The status of the ureter would be the same as that of the bladder, that is, traumatization with removal of artificial drainage before perfect function is restored.

The foregoing is offered in explanation of the renewed chills and fever which we occasionally have seen in the past in cases of pyelitis of pregnancy following ureteral catheter drainage with lavage of the kidney pelves. On the other hand, I believe that the postoperative type of retention requires only intermittent urethral catheter drainage and that a retention catheter would, in most cases, but the more surely cause a cystitis which, however, in only a small percentage of cases, will precipitate a pyelonephritis because there is no outlet obstruction but only a weakness (inhibition) of the bladder wall.

SUMMARY

In *postpartum* pyelonephritis with bladder retention in which catheter interference is indicated either from dysuria or toxicity, we meet with two entirely opposite types of bladder function. Either may exist separately or the two may co-exist to any degree.

The postpartum bladder showing a relatively fixed, compensated bladder wall back of a physiological block, motor and sensory, of the external sphincter, if of sufficient degree, requires continuous drainage when indicated by reason of infection. Such drainage primarily reduces bladder infection and, secondarily, urethral, pelvic and kidney infection by facilitating ureteral flow through a decompressed and perfectly drained bladder. Intermittent catheterization in such a bladder traumatizes in the presence of imperfect drainage and, therefore, tends to generalize of diffuse the infection. Irritative instillations in such bladders are contraindicated. Ureteral catheter drainage is only indicated when a primary ureteral block such as stone, stricture, etc., exists to complicate the usual clinical picture.

If sufficient degree of altered bladder function occurs, continuous bladder drainage is indicated until perfect function is restored.

The *postoperative* bladder with inhibited or functionally weakened bladder wall and with normal sphincter tone requires only intermittent catheterization. Frequently, one to three catheterizations will suffice to restore normal function. If not, the inhibition reflex is continued from the operative site. Irritating instillations in these bladders may be of value. Other postoperative types of retention are psychic or protective permitting the bladder to overdistend.

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SOME PRACTICAL CONSIDERATIONS IN THE TREATMENT OF LEUCORRHEA*

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THE treatment of leucorrhea must naturally be casual. The principal causes of this condition are discharge from the uterus, the cervix, the vaginal wall and the vulva. The pathological basis in the uterus is usually neoplastic or infectious and in the cervix we also find neoplasms and infections, particularly those secondary to injuries caused by childbirth.

The vagina and vulva are usually the site of infections. Some of the conditions just mentioned may require surgical treatment, but we will be more concerned with the local treatment in this presentation. Laceration of the cervix should be repaired and infected glands destroyed by linear scarification with the electrocautery. We have found the following procedure of great value in vaginal treatment. The vaginal speculum is introduced and the vagina is dried out. A tablespoonful of granulated sugar is put on a small piece of paper and a teaspoonful of ointment of the following composition:

Acid salicylici gr. 10
Ung. hydrarg. U.S.P. ℥ii
Ung. zinci q.s. loz.

is rolled in it and both the sugar and ointment are introduced into the vagina followed by a tampon. The tampon is removed in twenty-four hours and no douche is necessary. The sugar and ointment produce a syrupy mixture which is highly bacteriocidal and is effective for about one week. At the end of this time a new treatment is given.

This mixture has been found to be effective in gonorrhea and infection by trichonomos vaginalis as well as in the non-specific infections.

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FAMILIAL FIBROBLASTOMA OF THE PERIPHERAL NERVES

WITH A REPORT OF 2 CASES*

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ALTHOUGH in "The Anatomy of the Human Body," published in 1773, Cheselden[1] put on record the successful removal of a tumor of the peripheral nervous system, his claims to priority are generally ignored and the credit for being the first to recognize new growths of this kind has been given to Odier.[2] It was not, however, until 1811, thirty-eight years after Cheselden's operation, that the latter pointed out that tumors can arise from nerves and that neuromata, as he called them, may be defined as "deep-seated tumors characterized by painful swellings of the nerves involved." His conception is still accepted as fundamentally correct, even though pain is no longer believed to be a necessary concomitant of such new growths. Furthermore, Odier's loose use of the word neuroma, which he employed to designate any tumor of nervous origin, regardless of the specific tissue from which it develops, has caused considerable confusion. In 1828 William Wood,[1] from the observation of 24 cases, was able to conclude that some nerve tumors develop from the nerve substance proper and others from nervous connective tissue, but it remained for Virchow,[3] in 1863, to arrange the various groups of neuromata in an orderly fashion, on the basis of histologic rather than clinical differences. All nerve tumors, Virchow pointed out, are to be classified as true or false; the true variety arises from actual nerve tissue, whereas the false arises from the perineurium, the epineurium or the endoneurium. Thompson[4] in 1903 further divided false neuromata into two groups, the solitary, which arises from the connective tissue of the nerve, and the multiple, which is seen only in the entity known as von Recklinghausen's disease.

Table 1 includes the principal composite facts concerning true and false neuromata:

TABLE 1

Characteristic	*True*	*False*
Origin	Actual nerve tissue	Epineurium, perineurium, endoneurium
Site	Sympathetic nervous system	Any portion of nervous system, especially spinal nerves
Age incidence	Usually in children	Usually in first half of life
Potency	Benign	Often malignant, in form of neurosarcoma, or neuromyxoma
Number	Single or multiple	Single or multiple
Frequency	Relatively very rare	Relatively frequent

For many years after Virchow's classification little was written on the subject of nerve tumors. Increasingly effective methods of staining became available, but considerable confusion existed over such matters as the constitution of the axone, for instance, or the derivation of the sheath of Schwann, and while such fundamental facts were in dispute, it is not surprising that comparatively unimportant pathologic considerations should have been neglected. In 1908, however, Verocay[5] was able to establish the ectodermal origin of the sheath of Schwann, and to prove that tumors of the peripheral nerves arise from this structure and are therefore of ectodermal origin, and his conclusions have

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since been confirmed by Harrison[6] and Penfield.

In 1917, Fleming and Marvin[7] published a series of 3 cases of fibromyomata of the nerve sheath occurring in 3 individuals of the same family, and pointed out for the first time the familial tendency of discrete false myomata. A careful search of the literature since that date has revealed no further reference to this subject, and for that reason we desire to put on record the following 2 cases in which similar nerve tumors exhibited the same familial tendency.

CASE REPORTS

Case 1. Mrs. A. T., white, aged forty-five years, was admitted to Charity Hospital July 14, 1933. Her only complaint was a mass on the left thigh which had first been noticed in November, 1932, and which had progressively increased in size. For three years prior to this time there had been a sensation of weakness in the left leg, which had felt as if it were asleep, but there had been no increase in the severity of the symptoms since the appearance of the mass, although, almost coincident with their onset, she had developed a facial paralysis on the left side. Her story was otherwise without interest except for her casual statement that her daughter had a mass on the forearm similar to the one she herself had on the thigh.

Physical examination was essentially negative except for the face and the thigh. There was a complete paralysis of the left side of the face, which prevented closure of the left eyelid; the patient could not wrinkle this cheek, nor could she whistle, and the hearing in the left ear was markedly impaired. The etiology of this paralysis could not be determined, but it was considered of significance that it had developed almost simultaneously with the onset of the symptoms in the left leg.

On the posterior surface of the left thigh, about 6 cm. above the fold of the popliteal space, was a firm, apparently encapsulated tumor, about the size of a large goose egg. It was freely movable, there being no attachment evident either to the overlying subcutaneous fat or to the underlying bone. There was no local pain or tenderness, even on deep pressure, but manipulation of the tumor caused pain in the left foot. No inguinal or popliteal adenopathy was present. The left patellar reflex was moderately exaggerated, but the Babinski, Oppenheim, Chaddoch and Rhomberg reflexes were all negative, as were the routine laboratory tests, including the Wassermann reaction.

It was our impression that we were dealing with a tumor of the sciatic nerve, but rhabdomyoma was considered a possibility, as was aneurysm. Arteriography of the femoral vessels was therefore done with thorotrast by Dr. J. Ross Veal of this department; the roentgenogram definitely eliminated aneurysm and proved again the value of this method in the differential diagnosis of vascular disease of the extremities.

Operation was done July 17, under ether anesthesia (Drs. Miangolarra, Copland, Van Werden). An incision 15 cm. long, beginning about 3.5 cm. above the crease of the popliteal space, was made on the posterior aspect of the left thigh, directly over the course of the sciatic nerve. The outline of the tumor could be recognized immediately through the bulging subcutaneous fat which overlay it, and it came into view as soon as this fat and the biceps and semi-membranosus muscles were separated. It was about the size of a small alligator pear and was completely enveloped by the nerve sheath, the fibers of the sciatic nerve being frayed out over it. After the identification of the femoral vessels and the incision of the nerve sheath, it was seen that the lower pole of the tumor extended to the bifurcation of the sciatic nerve into the tibial and common peroneal branches, and its origin in the nerve sheath was quite clear. After careful dissection of the frayed filaments of the sciatic nerve attached to its anterior, lateral and medial aspects, the tumor was easily removed *in toto*. The nerve sheath was sutured over the nerve, the muscle planes were restored to their normal positions, and the skin was closed with a continuous interlocking dermal suture.

Recovery was uneventful and the patient was discharged July 24 in excellent condition. When she was seen two months later she walked without difficulty and with no impairment of gait, and she was able to carry on all the activities of a busy housewife with absolute comfort.

Grossly, the tumor, which measured 7.5 by 6 by 4 cm., resembled a cystic ovary. Its thin, bluish-pink walls were streaked with venous and arterial filaments, and in several areas

were noted bleb-like protrusions and rather extensive fat deposits. The pathologist's microscopic diagnosis was perineural fibroblastoma

Fig. 1. Case 1. Injection of femoral artery with thorotrast by Dr. J. Ross Veal. Note displacement of femoral artery by tumor, as well as definite elimination of arterial pathology.

undergoing cystic and degenerative changes.

Case II. S. T., white female, aged sixteen years, the daughter of the patient just described, was first seen August 14, 1933. She appeared in the clinic because one of us (Copland), recollecting Fleming and Marvin's report on familial neuromata, suspected that the tumor on the daughter's arm might be similar to the mother's tumor, and requested that she report for examination.

Both the history and the physical examination were without interest except for a tumor of the left forearm, which had been discovered some two years before. It had not increased in size and there had never been symptoms of any sort referable to it except pain in the left thumb when pressure was made over the mass or

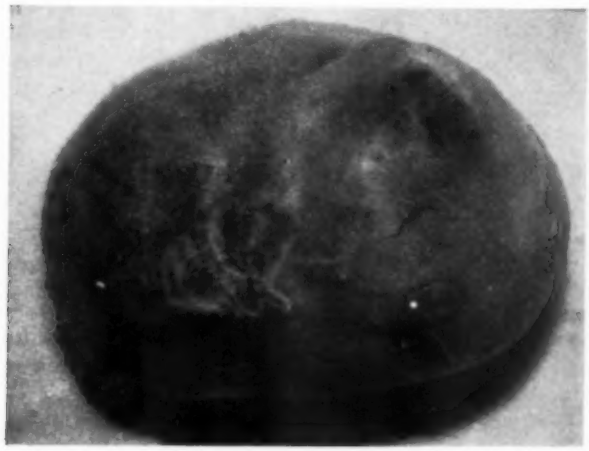

Fig. 2. Case 1. Tumor removed from sciatic nerve of mother. Note cystic character of growth and irregular masses in wall.

when it was accidentally struck. It was located on the volar aspect of the left forearm, in the midline, about 4 cm. below the fold of the antecubital fossa, and was about the size of an English walnut. It was quite firm and seemed to be encapsulated, and it gave the impression of being attached to some deeper structure because, although it was freely movable from side to side, it could not be moved from above downward. It was not tender on palpation, nor did the manipulation cause pain in it, though it did cause the pain in the left thumb which the patient had mentioned in her story. There was no muscular atrophy, no epitrochlear or axillary adenopathy, and no abnormality of the reflexes.

Routine laboratory studies, including the Wassermann reaction, were negative. Visualization of the parts with thorotrast was undertaken, as in the first case, but the picture was unsatisfactory because of an error in the technique and the examination was not repeated as it was quite clear that the neoplasm was a perineural tumor of the radial nerve.

Operation was done August 16, 1933, under ether anesthesia (Drs. Miangolarra, Copland, Van Werden). An incision 8 cm. in length, beginning about 5 cm. from the antecubital fossa, was made in the long axis of the volar surface of the left forearm, and was carried downward through the subcutaneous tissues until the tumor was encountered. After the adventitious structures about it were dissected

free, a knife handle was slipped under the mass from one side to the other, and it was thus determined that the upper and lower poles

Fig. 3. Case 1. (× 360). Section through wall of large cyst, showing formation of typical palisades.

were attached to the radial nerve, the fibers of which were seen to be frayed out over it posteriorly and medianly as soon as the nerve

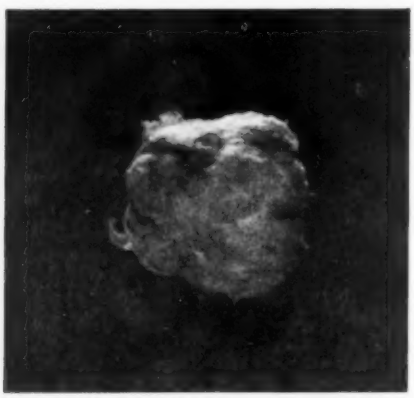

Fig. 4. Case 11. Hard, solid tumor removed from radial nerve of daughter.

sheath was incised. Enucleation was done without difficulty and without gross injury to the nerve filaments. The sheath was then sutured over the nerve, the fat was approximated with plain catgut, and the skin was closed with continuous interlocking catgut

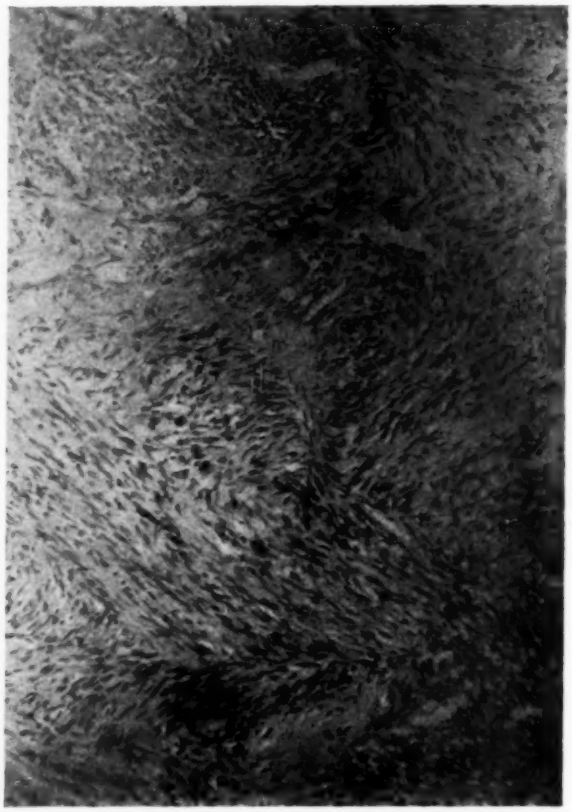

Fig. 5. Case 11. (× 120). Section through thickened portions of cyst wall, showing bundle-like arrangement of cell nuclei, with typical palisaded areas in center of picture.

sutures.

Convalescence was uneventful. On the first postoperative day the patient was able to move her hand with perfect freedom in all directions, and she was discharged three days later. Examination since then has shown a perfect anatomic and functional result.

A summary of the pathologist's report follows: This specimen consists of a tumor mass measuring 2.8 by 2.2 by 3 cm., which is slightly nodular on the surface. A portion of the thin capsule is missing, apparently as the result of surgical trauma. On section it appears soft, yellowish-gray in color, myxomatous in appearance, and relatively avascular. The microscopic diagnosis is fibroblastoma of the nerve sheath, with myxomatous degenerative changes.

COMMENT

Certain points of difference between our cases and the cases reported by Fleming

and Marvin[7] are immediately evident. Their cases occurred in the same generation of the family, ours in successive generations. Their family is of Jewish extraction, ours is Italian-Catholic. At least 2 of their 3 cases have trauma as a positive etiologic factor, whereas in neither of our cases could such a history be elicited, in spite of careful questioning. Their tumors are multiple, ours are single, though in our older patient the possibility of an acoustic nerve tumor has not been entirely dismissed. To date there is no evidence of it other than the facial paralysis, but the patient will be submitted to neurologic examinations at regular intervals in a further endeavor to demonstrate its presence.

The histologic factor in the Fleming and Marvin cases is fibromyxoma, whereas in our cases it is fibroblastoma, but it is the similarity of the strain in each group of cases rather than the precise histology which we wish to emphasize. Though we do not feel justified in drawing any conclusions from 2 cases, we do feel reasonably sure that we are dealing with the same clinical entity reported by Fleming and Marvin, familial tumors of the peripheral nerves, and we have felt justified in putting our cases on record, in order to supplement the very meager literature on the subject.

Benign tumors of the nerves usually, as Penfield[8] points out, arise from the nerve sheaths and do not invade true nervous tissue. They occur more frequently in the cranial nerve sheaths and the meninges proper than, as in our cases, along the peripheral nerves. Penfield[9] discusses them:

> The outstanding difference of opinion has to do with the question of whether these tumors are formed of connective tissue, of nerve fibers (neurinoma) or of sheath of Schwann cells, loosely called peripheral neuroglia. . . . The outstanding histologic characteristic . . . is the nature of the collagen fibers in them. These fibers are long, of even caliber, tend to be parallel, and are similar to the collagen or reticulin fibers found in the perineurium. It is because of the identity of these fibers that one must finally consider these tumors as fibroblastomas.

Grossly, both of our specimens fitted this description, the second tumor, with its characteristic yellowish color, being rather more typical than the first, in the walls of which were several nodular, herniated areas of fat. Both tumors were encapsulated and oval, and varied in consistency from solid to cystic. Microscopically the diagnosis in both cases was simple, because of the typical palisading of the nuclei, plus their linear arrangement. In neither case was there any evidence of cell division, and malignancy, therefore, was not a clinical consideration, as it was in at least one of the Fleming and Marvin group of cases. By the aid of sections stained by Mallory's phosphatungstic acid method the type of cells could be definitely demonstrated as fibroblasts, but we did not employ specific staining methods for collagen fat, as the diagnosis was so clear that this was not considered necessary.

Finally, a word must be said concerning nomenclature. Perineural fibroblastoma is one name for the type of tumor encountered in these 2 cases, this being the same neoplasm as the neurinoma of Verocay[10] and the schwannoma of Masson.[11] Other synonyms, according to Penfield, include solitary neurofibroma, fibroma of the nerves, peripheral glioma, gliofibrosarcoma, cerebello-pontile angle tumor, tumor of the nervus acusticus, and glioma of the acoustic nerve. Of this confusing collection of terms perineural fibroblastoma is probably least open to objection; peripheral glioma is an especially poor descriptive term, as are the terms derived from gross anatomic sites.

SUMMARY

1. Fibroblastoma of the peripheral nerves is a comparatively rare neoplasm.

2. Two cases of fibroblastoma are herewith reported, one of the sciatic and one of the radial nerve, which demonstrate the familial tendency of certain nerve tumors first emphasized by Fleming and Marvin in 1917 and apparently not again mentioned in the literature.

[For References see p. 426.]

ACUTE FRACTURES OF THE OS CALCIS

THEIR TREATMENT FROM THE INDUSTRIAL STANDPOINT

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INTRODUCTION

THIS is an injury which not only from the industrial standpoint but from a social, economical and insurance angle has been very costly. My paper is not presented with any other idea than that of trying to put this type of patient back to work in good condition and the figures and statistics herein presented are based on actual cases in which there is no attempt to camouflage the end-results.

I am of the opinion, after thirty years' observation, that the average physician considers this injury of minor importance. In many instances this is a wrong conclusion. Yet, at the same time, the physician should not be criticized too much because (1) the importance of the treatment of the initial condition has not been sufficiently brought to his attention; (2) he is interested in the many angles of his profession and calling in his own locality and does not have the time to concentrate on one particular injury. For that reason, I feel that in presenting the following method I may be of assistance to the general practitioner in helping him in the future to handle this condition.

DIAGNOSIS

When a patient goes to a physician with a history of a fall from some elevation, such as a step-ladder, window sill, fence or any elevation which permits that patient to drop a distance, coming in contact with a hard surface such as concrete, and the injury is related to the foot, that physician is justified in suspecting a fracture of the os calcis and especially so if the man lands on the soles of his feet. This can be confirmed objectively by a swelling and widening below the malleolar arch, particularly from the anteroposterior view, an immediate disability, pain, muscle spasm manifested by loss of lateral motion due to peroneal spasm and bony block, ecchymosis and occasionally crepitus, although as a rule most of these cases are impacted and do not exhibit crepitation.

X-RAYS

Taking all of these points into consideration, the attending physician should insist on *x*-rays, and when I say *x*-rays I mean a number of *x*-rays. Only too often the attending physician takes either no *x*-rays or only one view, which is insufficient. He should insist on at least four views as shown in the accompanying prints.

If it happens to be an industrial case, the attending physician should be permitted by his company to make sufficient views to control the treatment of the case; otherwise he should not be responsible for the end-results. If the private patient claims that he cannot afford the expense, then the physician should refuse to be responsible for the outcome.

TREATMENT

After such *x*-rays are taken, the doctor should explain to the patient as well as to the company, if it is an industrial case, the nature of the injury, the importance of proper treatment and that even under the best of circumstances a certain amount of change, not necessarily disabling, will unquestionably follow.

It is not necessary for me to cover all methods but I will attempt to show, by photographs and *x*-rays, the manner in which I handle this injury, giving my statistics. Incidentally, as to statistics, this is one thing in which industry as well as labor is interested. Using the immediate radical procedure in cases which come to me for *initial treatment*, I am able to keep the temporary disability down to an average of four and one-half months, with an average ultimate specific loss of 18 per cent (this figure having been arrived at by the compensation board of our state). Prior to my newer type of treatment, the average disability was from nine to sixteen months and longer with an average specific loss of 40 to 60 and sometimes 80 per cent. None of the 150 cases of which I have definite records, in which the patients were treated by me when they were first hurt and treated under my method, called for subsequent operation such as an arthrodesis.

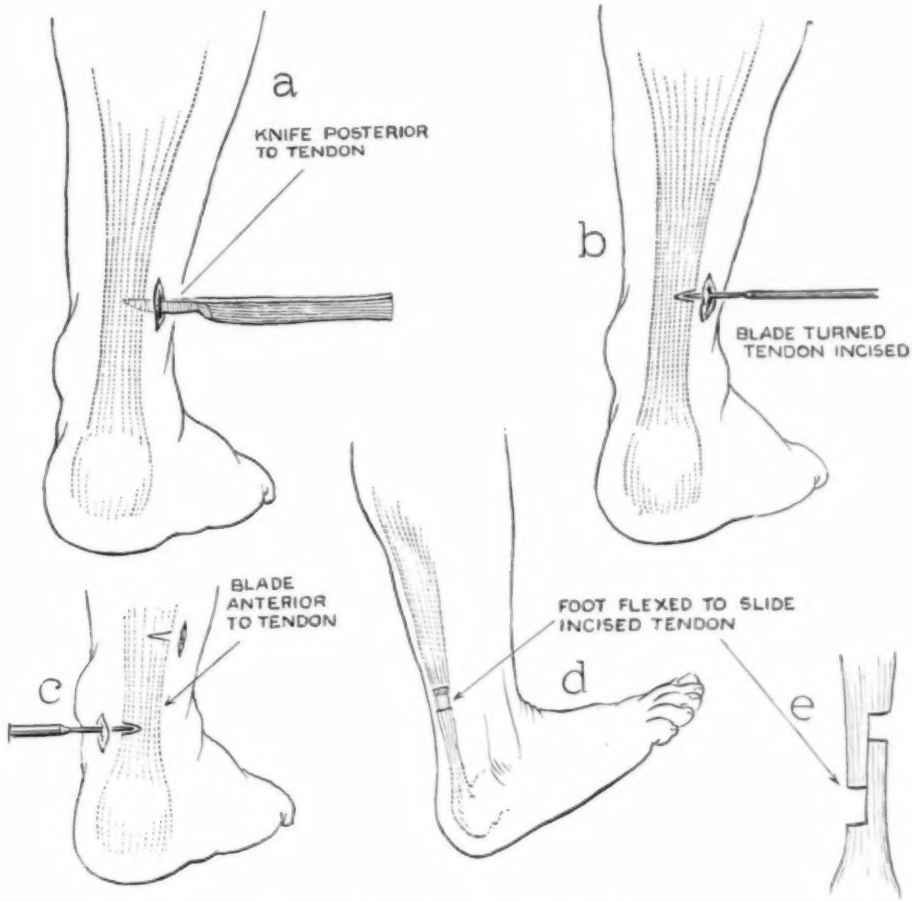

Fig. 1. Correction of acute os calcis.

These patients coming to me in the active stage, in other words *immediately following injury*, are thoroughly and completely *x*-rayed as shown by the accompanying illustrations. After this a temporary immobilizing cast is applied to relieve the spasm and pain, thus permitting the swelling to subside. This usually takes a week to ten days and the period of waiting can be carried out either in the home or hospital. At the end of that time a radical correction should be done.

As this type of trauma results in a flattening of the longitudinal arch as well as a widening below the malleolar arch, both of these defects must be corrected.

Therefore, following the reduction of the swelling, if the patient is not already in the hospital, I hospitalize him and prepare

FIG. 2.

FIG. 3.

FIG. 2. Application of splint and buttons.
FIG. 3. Manual pressure, pulling heel down.

him for the necessary treatment the night before. The limb is shaved and washed from the knee down, drenched with alcohol, then ether, and following that an alcohol pack is placed on the limb from the knee down to and including the foot. In the morning the only thing required, prior to operating, is the painting of the limb with iodine.

SURGICAL PROCEDURE

I first do a subcutaneous tenotomy of the tendo achilles, using the zig-zag method as shown in Figure 1, taking all muscle pull off the distal displaced fragment. Following this I proceed by direct traction to pull this posterior displaced fragment down as near normal as possible, restoring the original longitudinal arch. I then consider the correction of the lateral deformity or deformities below the malleoli. In this respect, utilizing the method devised by Böhler, of Vienna, I have added to my knee pressure splint the buttons devised by Böhler, and using them on the same splint am able to forcibly reduce the bony deformity below the malleoli (Fig. 2). This is all done at one and the same time. The buttons need be used only a few minutes, sufficient to reduce the deformity.

It is advisable while doing this to compare the abnormal with the normal foot which assists materially as a criterion from a comparative standpoint and acts as a controlling factor in the reduction.

4A

4B

4C

FIGS. 4A–C. Three steps of application of cast and walking iron

After the reduction is made with my instrument, I maintain that reduction by manual pressure (Fig. 3) pulling the heel down at the same time. At this point the plantar position of the foot is also maintained by keeping the ball of the great toe in plantar flexion instead of inversion. This not only assists in holding this reduction below the malleolar arch but also preserves the longitudinal arch, thereby preventing the traumatic flat foot. A study of the articulating bones of the foot will prove

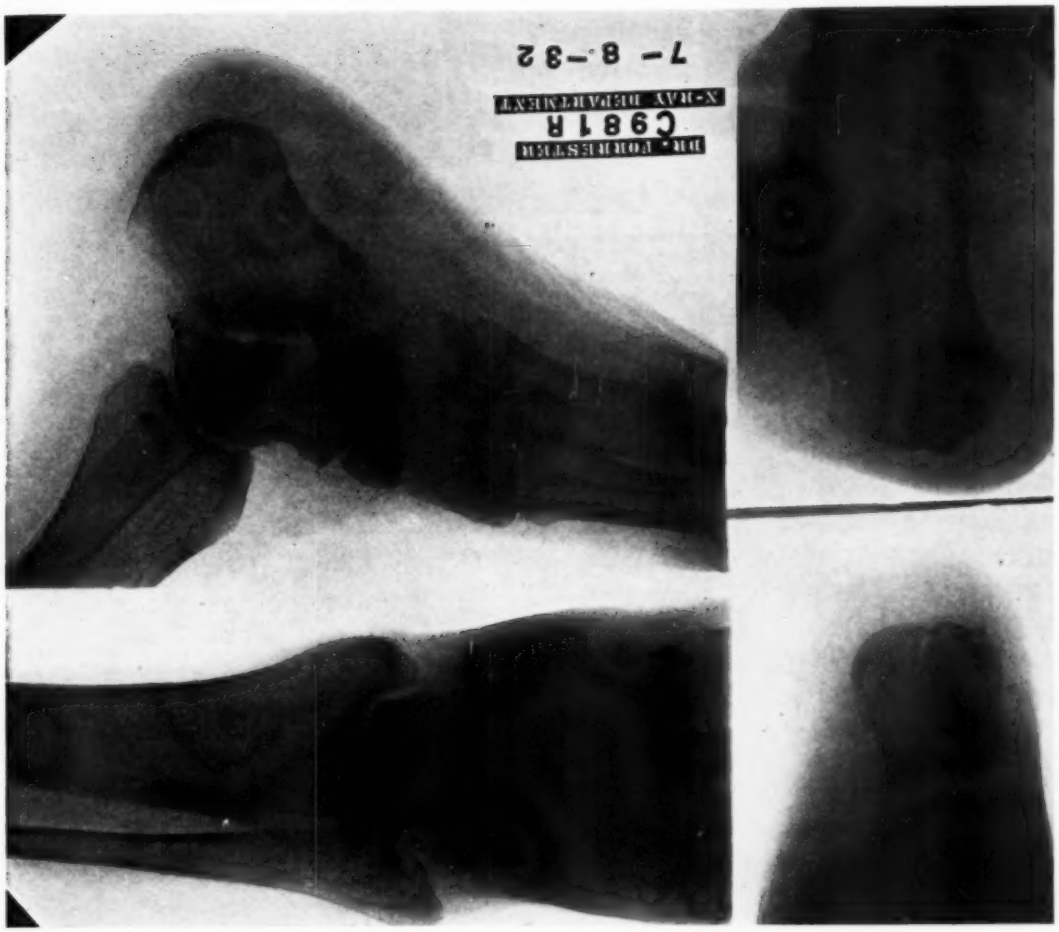

FIG. 5B. Case 1. X-ray taken July 8, 1932.

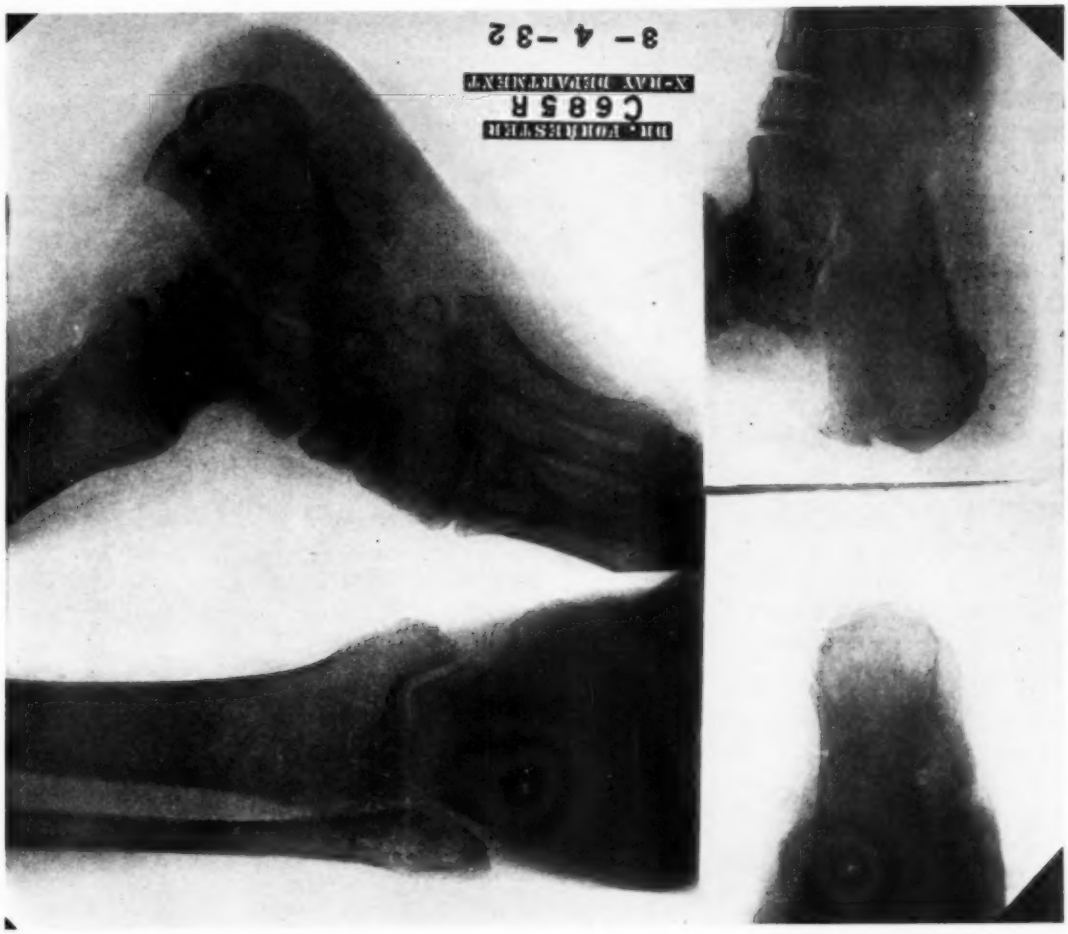

FIG. 5A. Case 1. X-ray taken April 30, 1932.

the logic of placing the foot in full plantar position with no inversion.

All of these factors being accomplished,

Fig. 6A. Case II. *X*-ray taken January 7, 1932.

I then apply a stockinette from the toes up to the knee, still holding the position of the fragments below the malleoli and the plantar position of the foot. A posterior plaster mould is then applied followed by a circular skin-fitting plaster cast in which I incorporate a walking iron (Figs. 4A, B and C).

I advise these patients not to bear any weight on the foot for the first twenty-four hours or until the plaster has hardened. After that they are instructed to walk on the cast *without* any other assistance such as crutches and to move the toes frequently each day, thus preventing any edema. These instructions, where a skin-fitting plaster cast has been applied, are imperative, otherwise the patient will come back with the toes swollen and possibly painful. This type of cast is maintained for at least two months. At the end of that time I apply either an elastic stocking or an Unna's boot for about sixty days, in the meantime, giving the patients education of all leg muscles, together with foot exercises and the ultimate use of the shoe worn previous to the accident.

I have hesitated a great deal in presenting this paper but after checking up my end-results and the ultimate findings of the industrial commission, I feel that it will be of value to the medical profession, particularly so in view of the fact that numerous orthopedic surgeons maintain that every os calcis fracture should be immediately arthrodesed. My results seem to contradict that position.

Following are a few unselected cases I have treated in which the actual disability and specific losses are shown (our figures have been derived from the final judgment of the industrial commission of our state).

Case I. (Figs. 5A and B.) J. S., aged thirty-eight. Injured April 28, 1932. Date of operation April 30, 1932. No hospital attention necessary. Period in cast and walking iron, eight weeks. Weight bearing started at end of eight weeks. Temporary disability, three and one-third months. Specific loss as established by Industrial Commission, 10 per cent.

Final results, January, 1934, by examination and interrogation.

1. Functional end-result: 100 per cent.
2. Was any surgery performed by anybody subsequently? No.
3. Are you able to do your usual full day's work and earn as much as you did before? Yes.
4. Any complaints on the part of the patient, (please note): No complaint; said "it could not be better; good as before." Wore arch supports two months, not necessary to wear longer.

Case II. (Figs. 6A, B, C.) D. H. B., Aged thirty-nine. Injured December 17, 1931. Date of operation December 26, 1931. Period in hospital, two days. Period in walking iron and cast, eight weeks. Weight bearing with shoe at end of eight weeks. Temporary disability, four months. Specific loss as established by Industrial Commission, 17½ per cent.

Final results, January, 1934, by examination and interrogation.

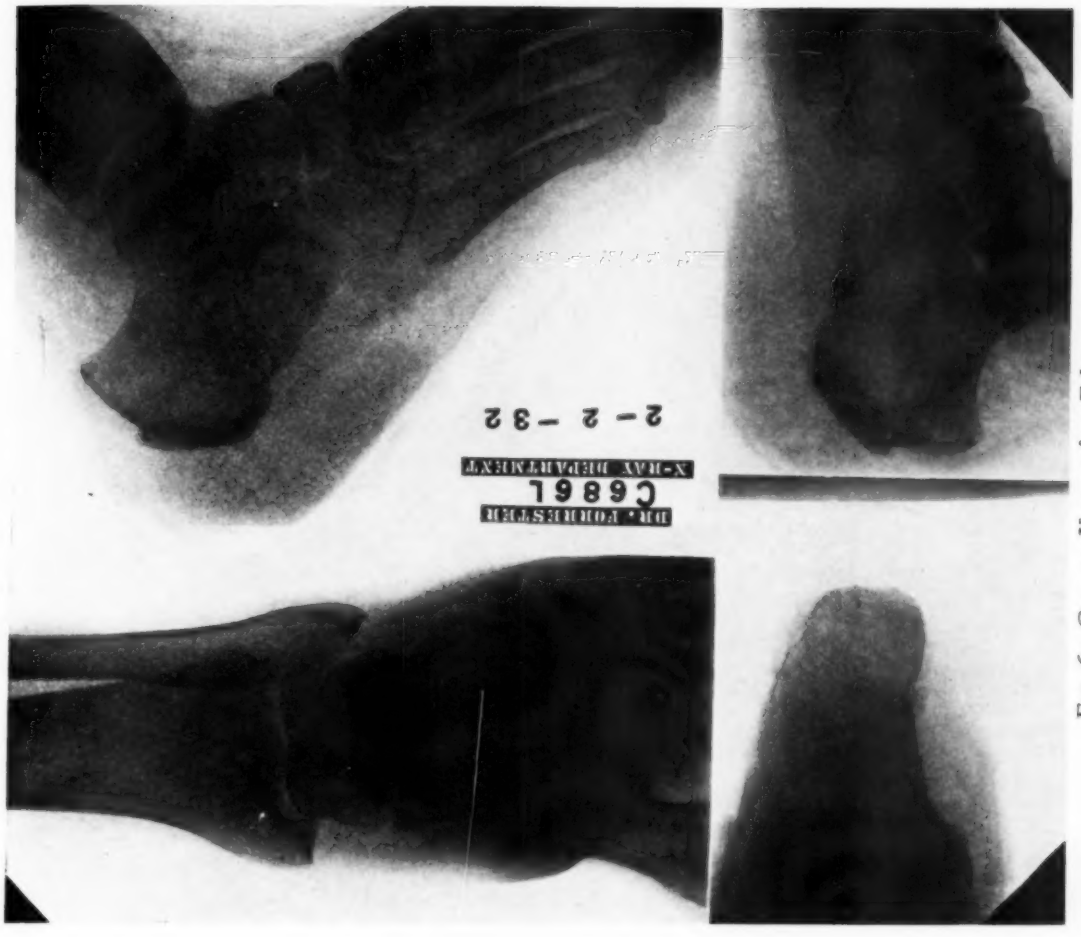

FIG. 6C. Case II. X-ray taken February 2, 1932.

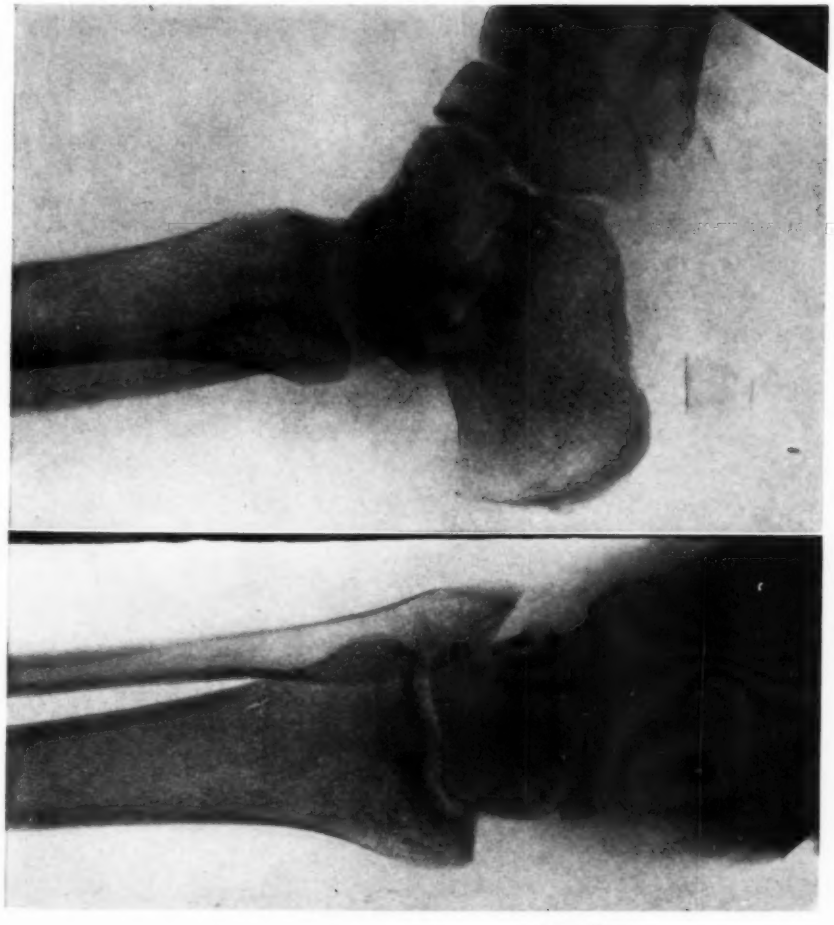

FIG. 6B. Case II. X-ray taken January 7, 1932.

FIG. 7A. Case III. *X*-ray taken January 7, 1932.

FIG. 7B. Case III. *X*-ray taken January 7, 1932.

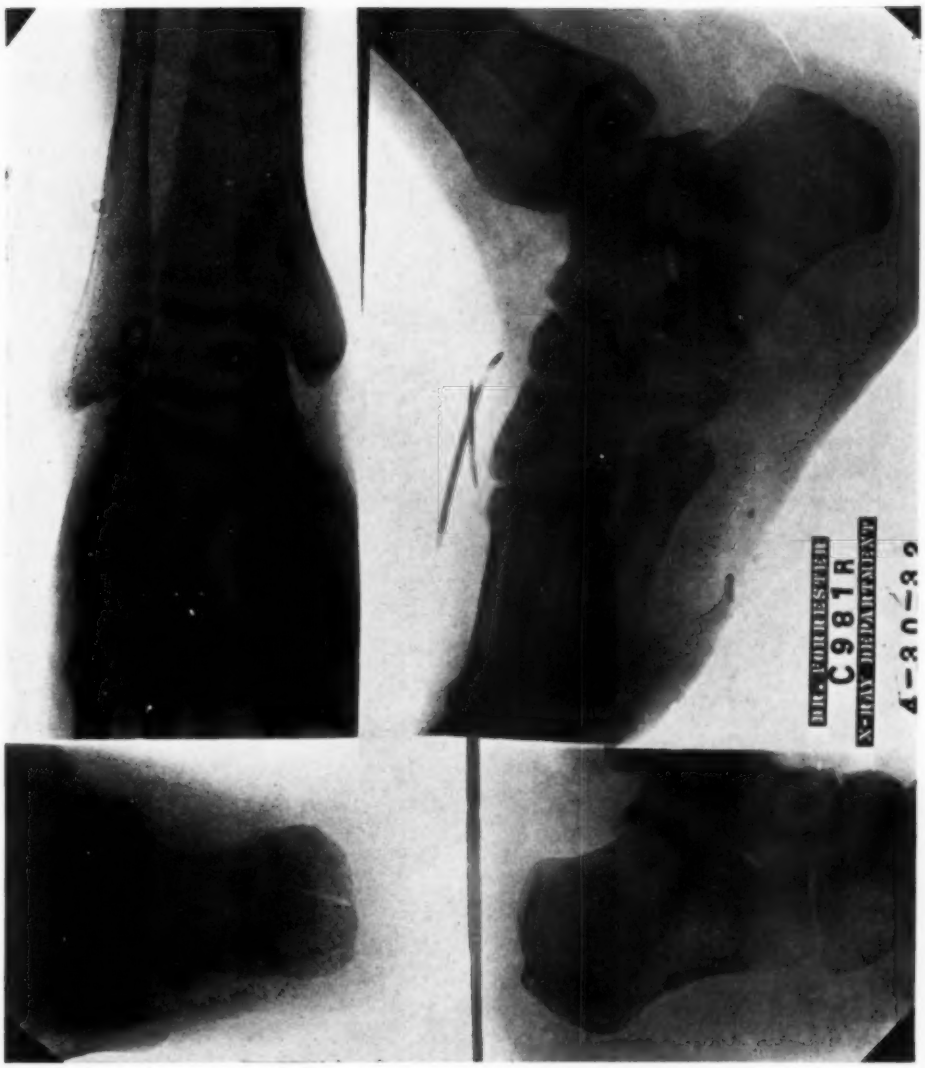

FIG. 7c. Case III. *X*-ray taken March 4, 1932.

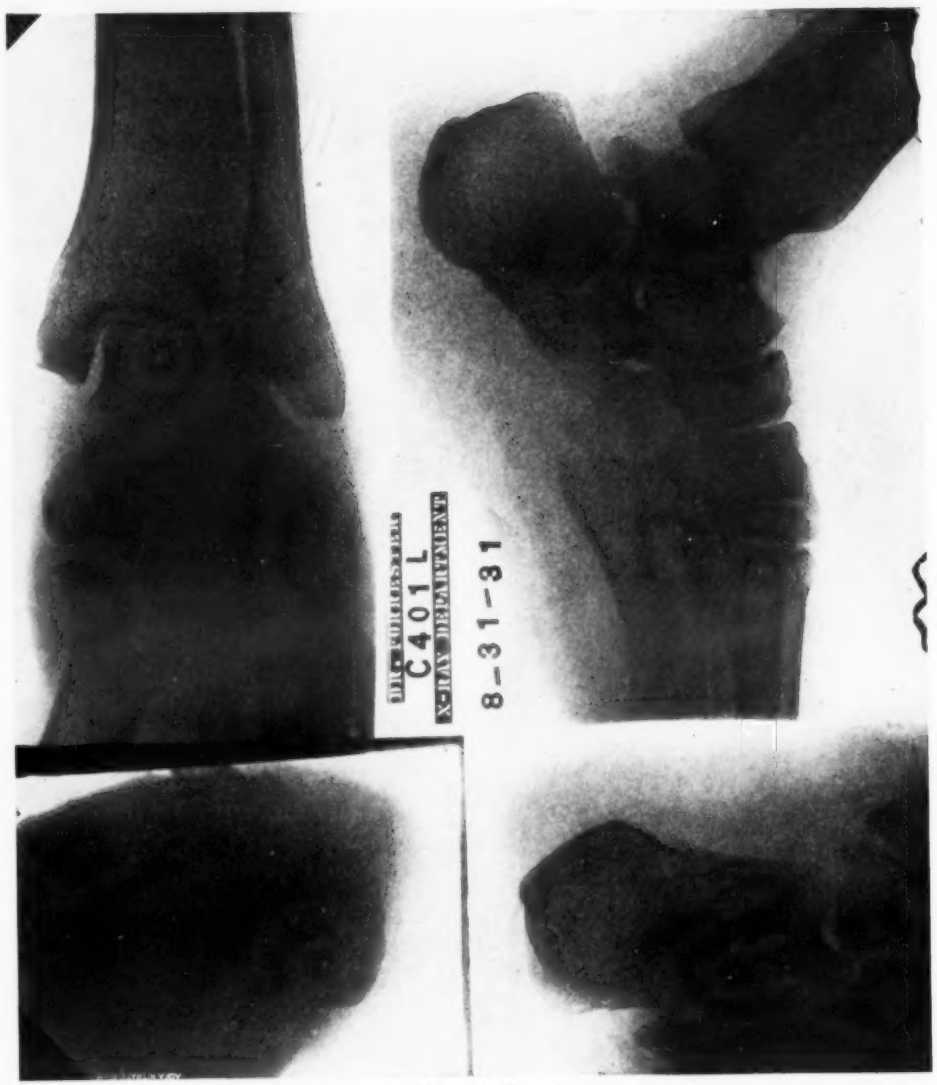

FIG. 8A. Case IV. *X*-ray taken August 31, 1931.

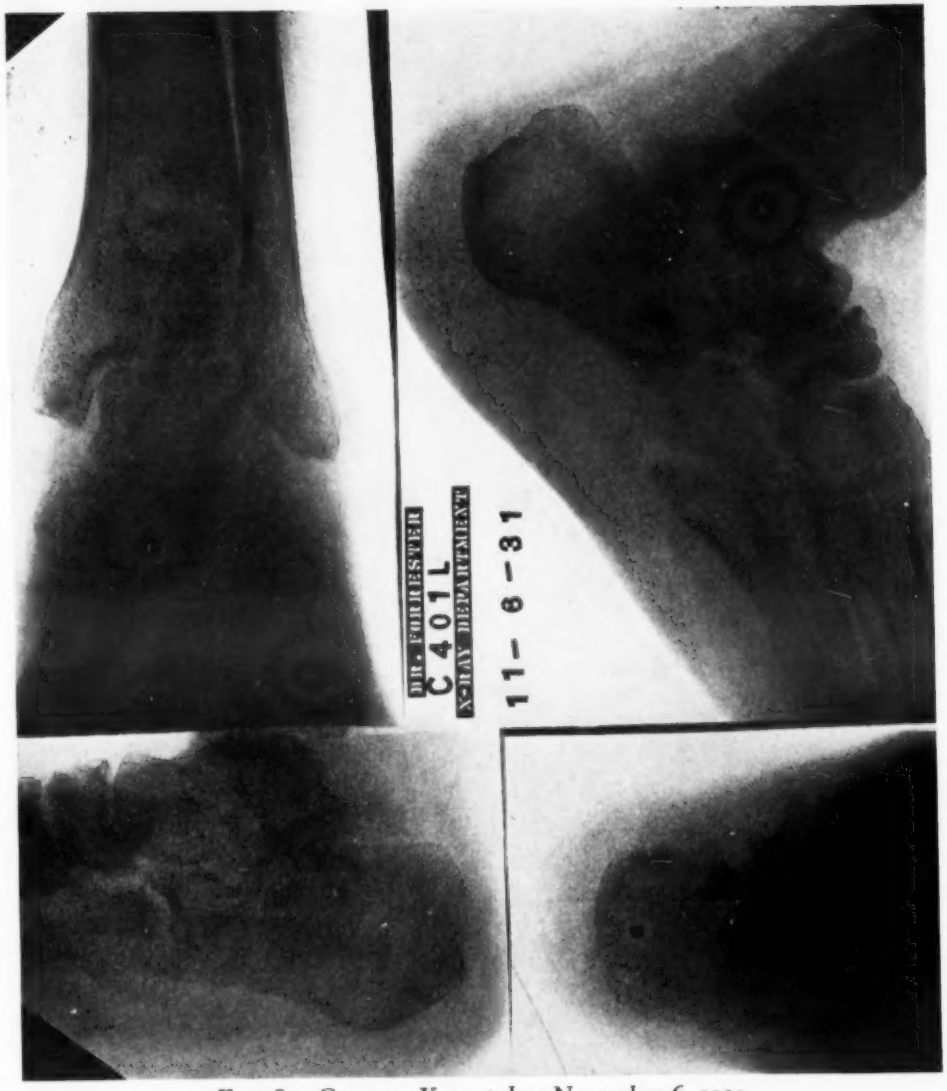

FIG. 8B. Case IV. *X*-ray taken November 6, 1931.

1. Functional end-result: good.

2. Was any surgery performed by anybody subsequently? No.

3. Are you able to do your usual full day's work and earn as much as you did before? Yes.

4. Any complaints on the part of the patient, (please note): No complaints: except when inverting foot he notices a pull below external malleolus. Wore arch supports for eighteen months; does not need them any longer.

Case III. (Figs. 7A, B, C.) S. S., aged forty-eight. Injured December 30, 1931. Date of operation January 4, 1932. Period in hospital, five days. Period in walking iron and cast, eight weeks. Weight bearing at end of eight weeks. Temporary disability, four months. Specific loss as established by Industrial Commission of Illinois, 22½ per cent.

Final results, January, 1934, by examination and interrogation.

1. Functional end-results: good.

2. Was any surgery performed by anybody subsequently? No.

3. Are you able to do your usual full day's work and earn as much as you did before? Yes.

4. Any complaints on the part of the patient, (please note): Is still wearing arch supports. If does not wear them has pain below external malleolus; some soreness beneath external malleolus on first arising; clears up in about one hour and nothing further troubles him during the day.

Case IV. (Figs. 8A and B.) W. J., aged forty-seven. Injured August 21, 1931. Date of operation September 2, 1931. Period in hospital, six days. Period in cast and walking iron, eight weeks. Weight bearing at the end of eight weeks. Temporary disability, four months. Specific loss as estimated by Industrial Commission, 20 per cent.

Final results, January, 1934, by examination and interrogation.

1. Functional end-result, perfect.

2. Was any surgery performed by anybody subsequently? No.

3. Are you able to do your usual full day's work and earn as much as you did before? Yes.

4. Any complaints on the part of the patient: No complaints at all. Man lost no time after cast and walking iron applied except for visits to the office. Says his foot is as good as before injury; is exactly the way he would have fixed it if he could. Does all kinds of heavy work such as piano moving, etc.

SUMMARY

A resumé of about 150 cases indicates that a combination of my type of treatment with Böhler's ambulatory cast and walking iron certainly results in a material reduction not only in temporary disability, which usually runs a year to a year and one-half, but also in the specific loss which in our State runs from 60 to at least 80 per cent. A computation of the cases here shown indicates an average disability of four and one-half months with an average ultimate specific loss of 18 per cent.

The technique is explained.

I wish to thank my associates, Drs. H. Stimson and A. H. Mason, also my roentgenologist, Mr. C. H. Hribel, who have so willingly helped me in compiling this paper.

A NOTE ON THE MANAGEMENT OF GUNSHOT WOUNDS OF THE HEAD IN CIVIL PRACTICE

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DETROIT, MICH.

GUNSHOT wounds of the scalp, skull and intracranial contents are commonplace in military experience but quite rare in civil practice. Excellent papers have been written on experiences of the Great War. First aid treatment of gunshot wounds by Crile and the operative management of perforating wounds of the skull by Cushing are among the excellent contributions on the subject. At the Receiving Hospital a considerable number of gunshot wounds of the head are admitted every year and it may be worth while to present a résumé of our experiences.

During a period of thirty-four months (January, 1930 to October, 1933) a total of 45 cases of gunshot wound of the skull were admitted to the Surgical Service. Thirty-two patients were men. Eight were colored. On studying the age incidence it was found that the majority belonged in the group between twenty-one and fifty; there were no cases under ten. About half were of suicidal intent, the remaining were either accidental, received in fighting or administered by the law. Of the suicidal patients all but one were men and all were white.

The entire group may be divided into two classes. First, those with no physical or *x*-ray evidence of skull injury (11 cases) and second, those in which there was demonstrable injury to the skull or its contents, or both (34 cases). Among those with no skull injury the possibility of associated brain damage should not be overlooked.

CASES WITH NO FRACTURED SKULL

The head wounds were of three general types. First, through-and-through wounds in which the bullet penetrated the scalp, traveled for a distance beneath it, making its exit at a different point. There were 5 such cases. Second, grazing wounds in which the bullet struck tangentially and cut a furrow in the scalp (3 cases). Third, puncture wounds in which only a rounded and punched-out wound was present (3 cases). The latter were *x*-rayed in order to locate the bullet in other parts of the body if present. In no case could the bullet be located. Assuming that the bullet was not anywhere in the body two possibilities became apparent, that (a) the bullet left the wound in which it entered, and (b) that a blank cartridge was used at close range. The latter can cause puncture wounds.

All 11 patients were conscious on admission and neurological examination revealed no abnormalities referable to the wound with the exception of one case. This patient walked into the hospital for first aid with a left mid-parietal wound and was released against advice. He returned the following day with right hemiplegia and aphasia. A left temporal exploration disclosed subdural hemorrhage and hemorrhagic brain surface. Two months later he regained speech practically in its entirety, motion returned to the lower extremity but there was little improvement to the upper extremity on the right. This case demonstrates the intracranial possibilities in cases with no apparent injury to the skull.

CASES WITH FRACTURED OR PERFORATED SKULL

There were 34 cases in this group. Ten entered the hospital conscious, 3 were semiconscious and 21 patients were unconscious. In 19 there was a wound of entrance

but none of exit. In 15 there was both a wound of entrance and exit. The most usual course was through and through right to left temple. In one case the outer table of the frontal sinus was penetrated but not the inner table. In 15, brain tissue was protruding from the wound. In 12 cases there was bleeding from the ear, nose or mouth.

As concerns the general course in the hospital this group may be divided into three types. First, those who showed rapid collapse (16 cases). All were unconscious. The temperature was rarely normal, often markedly subnormal, pulse was rapid, often uncountable, respirations were irregular, at times stertorous and occasionally of the Cheyne-Stokes type. The blood pressure when recorded was low. These patients exhibited a rapid and progressive failure of their circulatory and respiratory functions. Respiration became more and more irregular. Death was never in doubt and 11 of 16 died within two hours after admission. The maximum time before death was nine and one-half hours. In the second group there was a somewhat different picture. All were unconscious; pulse, respiration and temperature were within normal limits. These patients rapidly became worse and their temperature rose until marked hyperpyrexia was present before death. There was an associated increase in respiration and pulse. Five of 7 in this group died within sixteen to twenty-six hours after admission; one lingered on for five days. These people died a truly increased intracranial pressure death. In a third group of 11 cases the patients presented a marked contrast to the first two mentioned. All could answer questions; the temperature, pulse and respiration readings were approximately normal. The neurological findings varied in direct relation to the site of trauma. Of these, 2 died (one refused operation).

It is apparent from these groupings that those entering the hospital conscious, following a bullet wound of the head have a very good outlook for recovery and all should be done to help them and to prevent infection, and minimize post-traumatic sequelae.

MANAGEMENT

The rational of operative treatment of gunshot wounds of the head depends upon two factors: (1) The prevention of intracerebral infection; (2) the removal of bony particles, dead brain tissue and the bullet (if possible) to minimize post-traumatic sequelae. In gunshot wounds of the forehead region there is an added responsibility of holding at a minimum operative deformities of the skull.

In this group 7 cases were operated on in addition to first aid treatment. In one with no injury to the skull the operation consisted in removal of a subdural hematoma through a subtemporal approach. In 5 cases the operation consisted in removal of depressed fragments of bone and necrosed brain tissue. In this group the incision most usually used was horseshoe shaped in outline with the gunshot wound opening usually in the center. Of course, the type of incision used depends entirely on the extent of lacerations. In civil practice gunshot wounds are more usually circumscribed and smaller. The initial wounds were carefully debrided in every instance. With a flap incision the entire area of depression is exposed and there is a better opportunity to remove this area en masse. If the bone is then replaced the deformity would necessarily be less marked. Suction was used to remove particles of bone embedded in brain tissue and softened brain substance. If the bullet was in the close vicinity of the area operated on it was removed. If it was beyond our reach no attempt was made at removal. All but one were closed without drainage. In one case of old gunshot wound with bullet on the wall of the body of the right lateral ventricle there were evidences of increased intracranial pressure, namely, choked discs and headaches. There was also motor cortex irritation evidenced by left patellar and ankle clonus and notice-

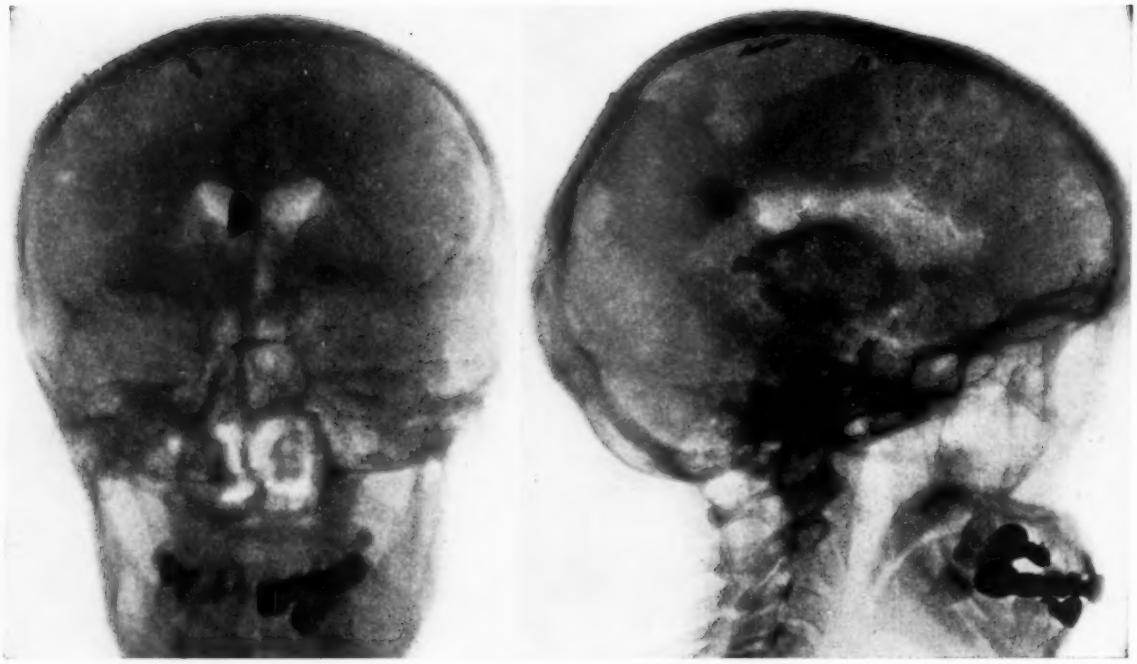

FIG. 1A. FIG. 1B.

FIG. 1. Bullet wound of the head seen two years after trauma for headaches. Examination also showed bilateral choked discs and evidences of motor irritation in left lower limb. Suspected cyst about bullet. First operation did not disclose cyst formation. Decompression was thought sufficient but this only cured complaints. Area of decompression grew to massive size. Second operation, encephalogram and removal of bullet. No evidences of pressure since. Apparently, bullet behaved like a brain tumor and cure could not be effected without its removal.

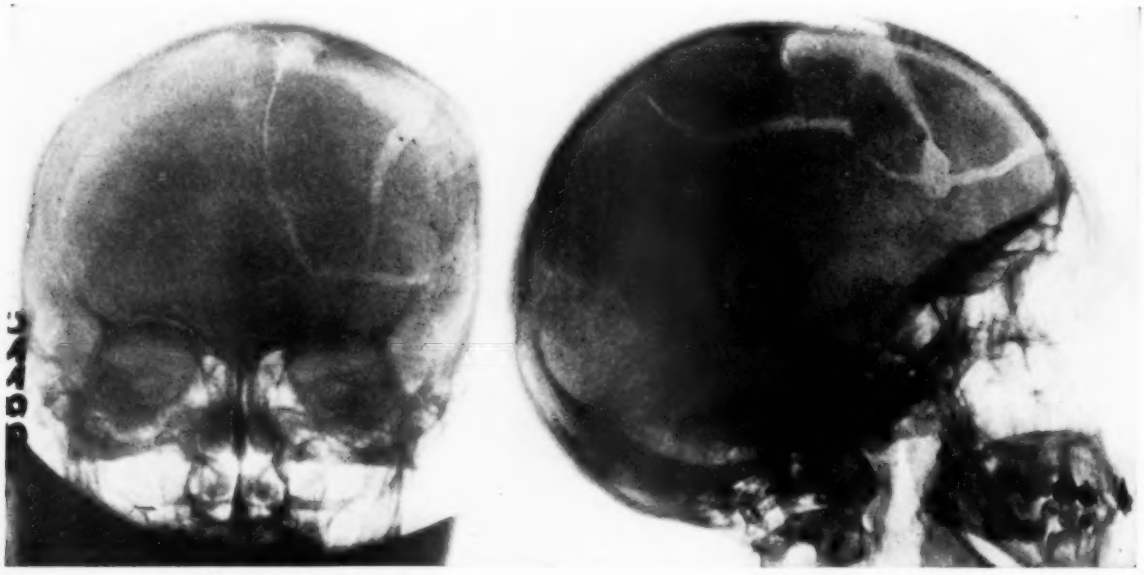

FIG. 2A. FIG. 2B.

FIG. 2. Gunshot wound of right frontoparietal. Extensive comminution of fragments. Marked cerebral destruction and softening. Patient operated on twenty-six hours after admission. Repaired without drainage. Healed by first intention. Initial left hemiplegia cleared up completely. Patient has had no sequelae up to present (thirty-two months). Pieces of bone were carefully preserved and replaced to minimize forehead deformities.

able spasticity of the left lower limb. Because of its position and because of no evidences of cyst formation about the bullet we were satisfied with a decompression at the first operation. Although this cured the headaches and the choked discs the area of decompression grew to massive size and only after the removal of the bullet did this subside. It was justifiably concluded that the bullet acted like a brain tumor and cure could not be effected without its removal. The accompanying encephalogram (Fig. 1) shows normal ventricular contour in this case. This patient now has a slight residual paresis in the left upper limb.

In general the management of gunshot wounds of the head in this hospital consisted in (1) combatting shock when present; (2) first aid care of wounds, namely, shaving off scalp hair, cleansing and dressing of wounds; (3) administration of antitetanic serum; (4) careful *x*-ray examination if patient's condition permits; (5) operation of debridement, cleansing of wound, removal of bony particles and dead brain tissue. This is done as soon as the patient's condition permits. Local anesthesia is preferred.

Fig. 3. Traumatic porencephaly, right frontal. Gunshot wound of right forehead in 1918. Patient employed as a type-setter from 1919 to 1930. Apparently, no complaints during this period and a good wage earner. Since 1930 spells of epilepsy ten to fifteen times yearly. It is interesting that with such a porencephlic cavity patient was able to carry on satisfactorily and earn a good living for eleven years before pathology made itself evident.

COMMENT

The management of gunshot wounds of the head is essentially similar to that of head injuries with different etiology. There are some differences, namely, that the bullet may remain in the cranial cavity and that there is a greater possibility of shattered pieces of bone being dispursed through the brain in the direct vicinity of the wound of entrance. Otherwise, the treatment is one of compound fracture and it aims at prevention of intracerebral infection and minimizing post-traumatic sequelae. The wound is debrided in the usual manner, all foreign particles and pieces of bone are removed, the softened and necrosed brain tissue is carefully sucked away, and the wound is closed without drainage except in the region of the frontal sinus. When the bullet is lodged in the brain close to the wound of entrance removal is good technique. If, however, it is at a great distance from its point of entrance, such as diagonally across in the opposite hemisphere, no attempt is made to remove it, as long as the patient carries on satisfactorily. There are many in this group carrying a bullet in the head which apparently causes no dysfunction. However, we realize that in some, post-traumatic sequelae may not be evident for years (see Fig. 3). To be dogmatic about this matter would cause much disability which should not be borne by the patient. In some there are eventual evidences which spell surgical intervention. A cyst may form about the bullet which may necessitate exploration. Actual fibrous tissue tumor may envelop the bullet (Dandy). In the case just discussed the bullet had lodged on the wall of the body of the right lateral ventricle. The patient

came in two years later with choked discs, headaches, and she was explored for a possible cyst about the bullet. No cyst being found a decompression was performed but this only relieved the complaints. The area of decompression protruded to massive size. At a later date the bullet was removed and since, there have been no evidences of pressure. It was justifiably concluded that the bullet behaved very much the same as a brain tumor and cure could not be effected without its removal. However, this is an exceptional case and it is not a true argument for attempts at removal of bullets embedded deep in brain substance, for a majority undoubtedly do as well as could be expected. Certainly there is no guarantee that the removal of bullet will eliminate all undesirable sequelae. Where there are clinical evidences later, the case can be dealt with surgically.

SUMMARY

1. In gunshot wounds of the head the aim is to prevent intracerebral infection and to minimize undesirable post-traumatic sequelae. Debridement and removal of dead brain tissue, foreign particles, shattered pieces of bone and the bullet (if possible) will help toward this end. Shock should always be treated first even if this takes twenty-four to thirty-six hours.

2. The state of consciousness is of prognostic importance. Patients conscious on entrance or soon after represent the most favorable class for recovery, irrespective of extent of apparent trauma. In this group recovery obtained in about 80 per cent. Among those in deep coma death occurred either soon after entrance (rapid collapse) or after the first twelve to fifteen hours from extreme hyperpyrexia and increased intracranial pressure (hyperpyrexic death).

3. In the absence of skull injury, damage to the intracranial contents should not be dismissed as a possibility. An example of subdural hemorrhage with no fracture or perforation of the skull is given.

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COMPRESSION FRACTURES OF VERTEBRAL BODIES

A NEW METHOD OF ATTEMPT AT REDUCTION AND IMMOBILIZATION

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THE object of this paper is to present a new method of attempt at reduction of compression fractures of the thoracic and lumbar vertebrae, together with an improved method of constructing a plaster shell to maintain the corrected position.

Heretofore attempts at reduction of these fractures have been confined mainly to hyperextension in or on various types of frames, patterned after the frequently described Bradford frame, or in an enveloping cast extending from the neck to the knees. More recently the Rogers frame has been heralded by some authorities as the ideal type because its force can be directed to any given point along the spine. My experience with these types of frames is limited to the management of 6 cases.

Until a few years ago it was thought we were able to reduce the amount of compression, in this type of vertebral injury, by stretching the patient by means of a double Buck's extension with countertraction by raising the foot of the bed, or by hanging a weight, through a pulley arrangement, to the patient's head. It took more than ten years to realize the uselessness of such a procedure.

The fruitlessness of these types of treatment led to the search for a method of reduction during the acute stage of the injury, that is, during the first forty-eight hours. Moreover, a method of external fixation that is not comfortable is, in my opinion, not successful. Neither the circular enveloping cast or the hyperextension frame is comfortable because they do not fit the patient.

For convenience, these crushing injuries of the vertebral bodies are classified into three distinct types or degrees, depending upon severity: the mild or first degree, the moderate or second degree and the severe or third degree. Either of these types may or may not be accompanied by other vertebral fractures and cord injuries.

The mild, or first degree, is that type in which the bone is only slightly wedge shaped, not more than one-fourth the thickness of the vertebral body, upon the lateral view, causing only a rounded kyphotic deformity.

The moderate, or second degree, is that type in which the anterior border or the body is half or less than half the thickness of the normal body with a very definite kyphotic angulation and possibly partial or complete dislocation of the articular processes.

The severe, or third degree, is that type in which there is a marked destruction of the vertebral body with a very marked wedge shape and a very emphatic kyphotic angulation. This type is usually accompanied by a dislocation at the articular processes of the affected vertebra or the one above it. Also, in this type, the superior or inferior borders, or both, are comminuted.

So far as I know this classification may be original also, since I have never seen it in print. In any case it serves splendidly in planning the treatment of these conditions.

Before going into the description of this method of reduction I desire to call attention to the the fact that most of our authorities seem to agree that these fractures are impacted. I am not convinced that this is always true. A percentage of them are comminuted fractures with very little or no impaction. To convince myself

on this point I obtained two specimens and dissected them. One of these patients died five days after injury from septicemia of

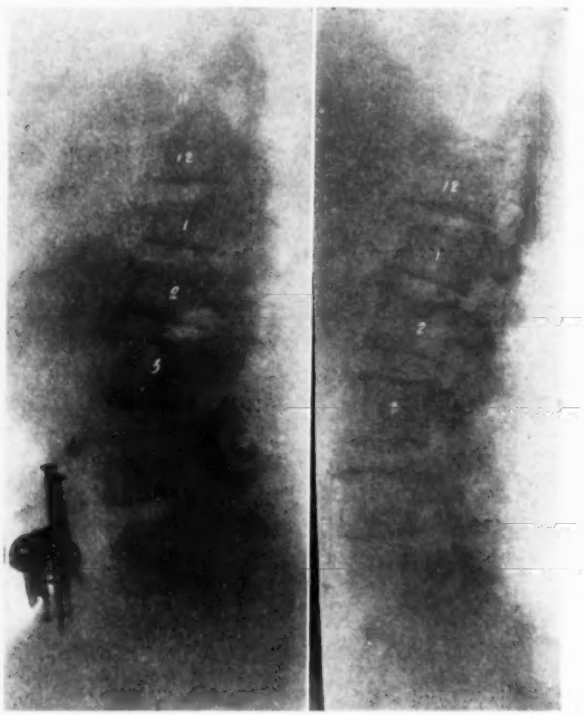

Fig. 1. Fig. 2.

Fig. 1. Second degree type compression fracture, in man aged fifty-three, sustained by falling from roof alighting on his buttocks. No cord involvement.

Fig. 2. Same case as Figure 1 five months later. Treatment after manner described in this paper.

pneumonic origin. The other died within twenty-four hours from other injuries. Neither of these specimens was impacted and both presented evidences of a sort of rotary mechanism at the site of fracture. The strong anterior common and lateral vertebral ligaments, together with the ligamenta subflava were folded upon themselves, in these specimens, but were not torn or lacerated. The posterior common, supraspinous and interspinous ligaments were torn free in one case, thus allowing the spinous process to be elevated. Study of these two specimens led to the conclusion that early reduction can be accomplished and should be attempted as soon as is practicable after the injury. (See Figs. 4 and 6.) Obviously specimens of these fractures are hard to get at a time they are most serviceable for study.

The mechanism of these injuries is essentially one of hyperflexion though usually, as stated before, there is a rotary

Fig. 3. Third degree compression fracture of tenth dorsal vertebra, one year after injury in automobile accident. Negro woman, aged forty. Refused treatment of any kind because of religious fanaticism. No cord involvement.

action in the process. The upper lumbar and lower thoracic regions are most often affected. Normally flexion and extension are free in the neck and lumbar region. Rotation is slight in the cervical region, below the axis, free in the upper portion of the dorsal, and gradually diminishes to become absent in the lumbar region. The thoracic cage is a great protection to the upper dorsal vertebrae against the mechanism of hyperflexion.

In planning this type of treatment one must take into consideration the degree of severity of the compression, whether or not the laminae or spinous processes are fractured, injury to the cord, other injuries sustained and the general physical condition of the patient. The indications are about the same as those considered for the ordinary hyperextension methods.

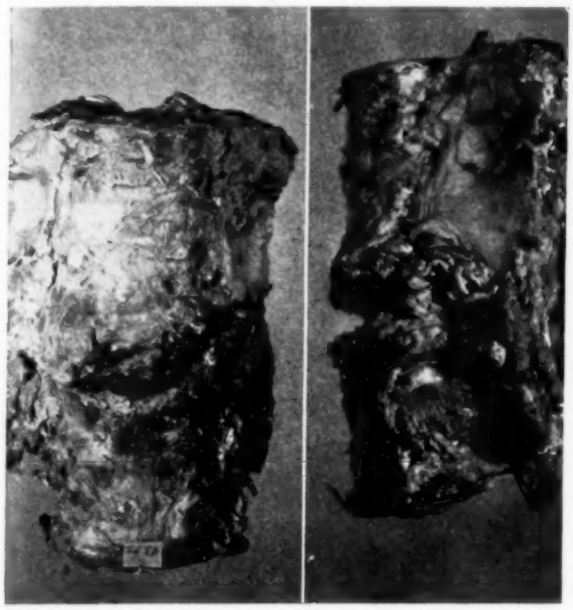

Fig. 4. Actual specimen of compression fracture of first lumbar vertebra removed at autopsy from patient who died from pulmonary complications five days after injury. Strong anterior longitudinal ligament was severed by operator for purposes of study.

The first step in this plan of treatment is a twenty-four to thirty-six hour study of the patient including *x*-ray study. A double Buck's extension is applied, with 12 to 18 pounds of weight to each leg, with the foot of the bed raised to the height necessary to exert counter-traction. This relieves the painful muscle spasm in the back and thighs. If no neurological symptoms develop within twenty-four to thirty-six hours it is reasonably safe to assume there is no injury to, or hemorrhage into, the cord and we may proceed with the reduction and construction of the cast. If these symptoms do develop a laminectomy may be considered. Laminectomy is indicated in increasing neurological signs and stationary signs with block.

In 90 per cent of these cases the patient suspects his back is broken, as he terms it, before the surgeon sees him, and he is frightened. The human race has forever had a special horror of broken necks and broken backs, because they have always stood as the symbols of death. If fracture is present it does no good to deny it to the patient because the subsequent treatment belies the denial. Rather it is better to admit the injury and minimize the dangers with proper reasoning and thus gain his absolute confidence because his thorough cooperation is required later on. This is a part of the first period of management of the case.

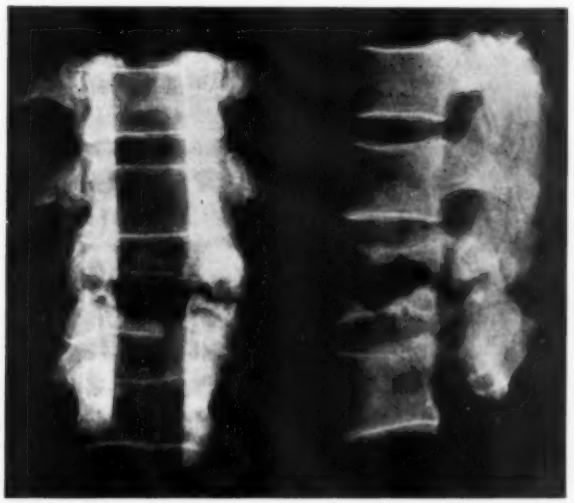

Fig. 5. *X*-ray views of same case as illustrated in Figure 4. Obviously these specimens are hard to obtain at a time when they are most serviceable for study owing to fact that few of these patients die until after healing is well advanced. This patient suffered no cord involvement.

Method of Reduction

I prefer profound ether anesthesia.

The patient is anesthetized on the wheel carriage. While anesthesia is being induced preparation for the reduction and construction of the cast shell may be going on.

If the fracture is located in the 12th dorsal, 1st, 2nd, 3rd or 4th lumbar vertebra hyperextension can best be obtained by swinging the patient between two tables,

face down, one table, properly padded, beneath his chest and the other beneath the upper thirds of his thighs. The patient

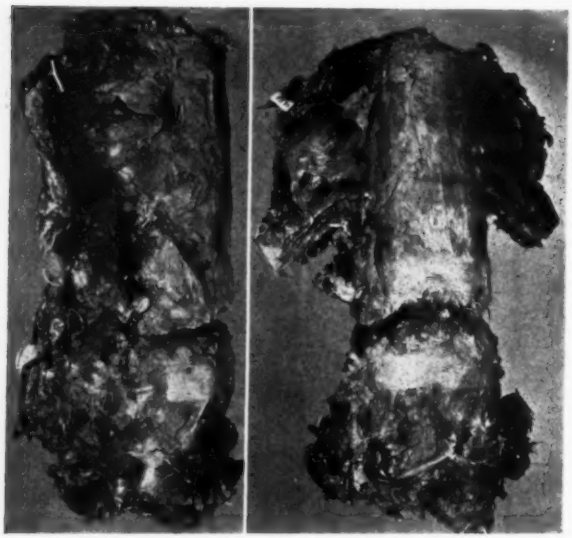

FIG. 6A. FIG. 6B.

FIGS. 6A and B. Actual specimen of compression fracture of second lumbar vertebra obtained at autopsy twenty-four hours after injury in railroad accident. White man, aged twenty-three years, who died from other injuries, including severed right arm and leg and acute brain injury. There was extensive cord involvement. Anterior longitudinal ligament was severed by operator for purposes of study.

is to be placed in this position very gently.

If the fracture is above the 12th dorsal the position is the same except the table or elevation under the chest is moved upward, toward the shoulders, the neck also being hyperextended by means of elevation or suspension of the head, and the second table placed under the hips or pelvis. The elevation of the hips or pelvis should be considerably higher than that of the shoulders. This insures more hyperextension of the dorsal region and less of the lumbar region.

Then a piece of felt is cut, from measurements, to fit the patient's back allowing for the arms and the use of a bed or douche pan. This felt should extend from well over the shoulders to about the level of the greater trouchanters and to the anterior axillary line on either side. During the time required for cutting of the felt the patient has had time to become completely anesthetized and relaxed in his new position. From five to seven minutes are usually required to prepare the felt.

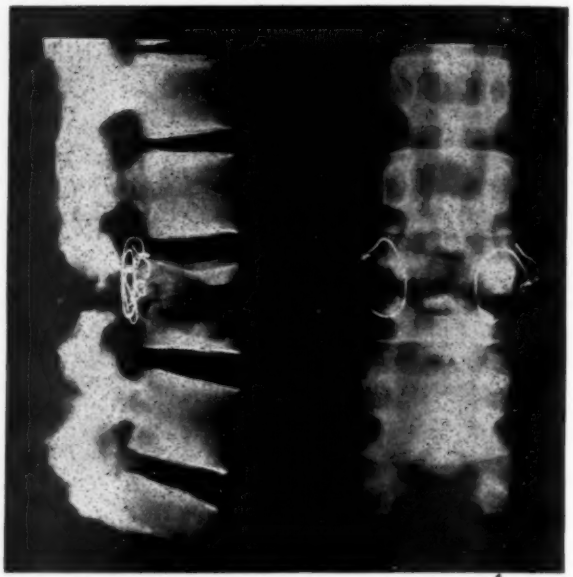

FIG. 7. *X*-ray of same case as Figure 6. Wires were used to maintain position after study by class. Observe comminution of fragments in both specimens.

Palpation over the injured vertebra will reveal a slight "hump" or prominence present. If so place a sand bag, about 2 inches thick and about 4 inches broad, directly over the injured vertebra and strike the bag several times with quick sharp blows using a hammer weighing from 2 to 4 pounds. I use an ordinary carpenter's hammer, striking with the flat surface. The object of the sand bag is to distribute the force and to protect the soft as well as bony structures. If after several of these quick sharp strokes palpation reveals that a bony prominence or "hump" still remains, replace the sand bag and deliver several additional strokes. This should be kept up until the "hump" disappears or until it is obvious there is an impaction of such a degree that it is deemed impossible to break it up. One such case was found in the 32 upon which this type of reduction was attempted.

I will theorize for a moment, since this completes the process of reduction. If there is a mild impaction or if the fragments are being held together by the

action of the strong anterior muscles of the spine it is my opinion the quick sharp blows will do more toward releasing the impaction, as well as the muscular action, than long drawn out hyperextension without anesthesia and its consequent relaxation. No fear need be entertained concerning the operation, for it is next to impossible to tear the anterior common or longitudinal ligament or the anterior short intervertebral ligaments. A dissection of these structures will convince any surgeon upon that point.

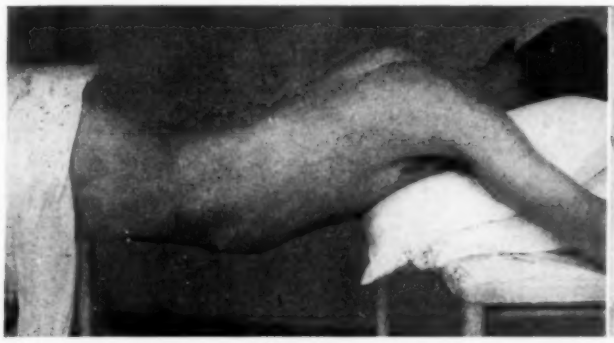

FIG. 8.

FIG. 9.

FIG. 8. Proper position for attempt at reduction by "hammering" process and application of hyperextension shell in compression fractures in lumbar region.

FIG. 9. Proper position for attempt at reduction by "hammering" process and application of hyperextension shell shell for fractures in lower dorsal region.

CONSTRUCTION OF THE CAST

No claim as to the origin of the posterior plaster shell idea is made here but it is thought that this method of construction of the shell is an improvement. When the attempt at reduction is completed the posterior felt jacket is fitted to the patient and held in position by adhesive plaster. The felt is cut transversely at a point just above the crests of the ilia sufficiently to make it fit the patient's waist. There should be no wrinkles whatever when the cast is completed.

Then, using 6 inch widths, beginning well over the shoulders, the plaster bandage is laid transversely. The first layer is most important. It should be laid smoothly and each fold should go well beyond the margin of the felt. Then the plaster must be rubbed and smoothed to fit every depression and every prominence of the patient's back as perceived through the felt. This constitutes comfort for the patient later on and insures maintenance of position since he can lie in it only as it fits.

After this first layer begins to "set" others are added longitudinally and obliquely in both directions and again transversely to the number of from twelve to fifteen. The same precautions as to rubbing out air holes and overlapping layers are carried out in this type of cast as is necessary in any other type. When the shell is made and the finishing touches applied it is allowed to remain on the patient for a few minutes until it hardens. Then it is simply lifted off and set aside for trimming.

The patient is returned to his bed with a pillow beneath his back with the most pressure directed to the point desired.

Before the shell becomes hard it is trimmed to conform to the size of the felt. For this purpose I use a Bard-Parker knife and all the old blades which have accumulated in the operating room for the past month. The thinner the blade the easier it cuts a wet case. When the trimming process is completed the shell is set aside to dry. Drying usually requires from twenty-four to forty-eight hours, depending somewha upon the weather. When the shell has become thoroughly dried a piece of stocki-

nette is stretched over the inner side and held with adhesive plaster. Or an ordinary cotton undershirt, cut and sewed to fit and he is allowed to flex his knees as he desires.

The patient may return home any time

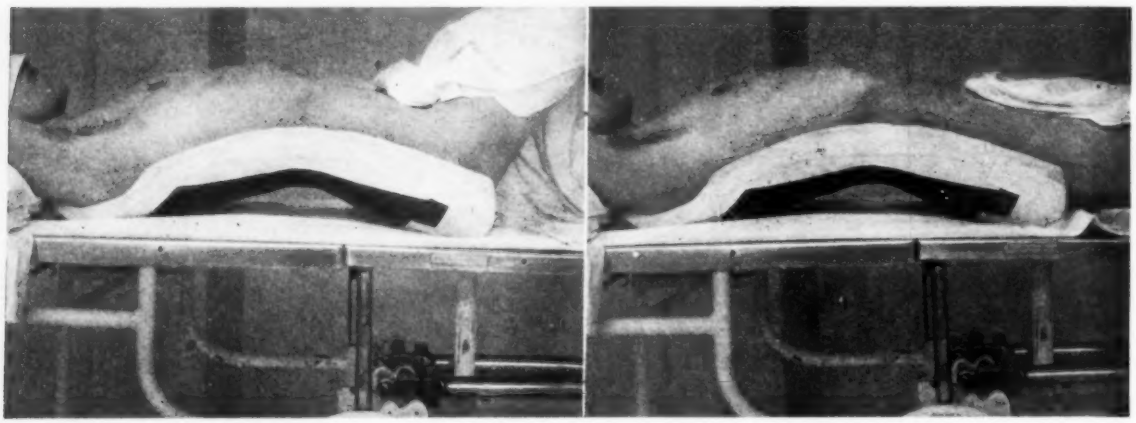

FIG. 10. FIG. 11.

FIGS. 10 and 11. Shell completed. Note that position of legs does not alter amount of hyperextension. This shell is cut lower than usual in order that patient may be seen to better advantage. Shell should extend laterally to mid-axillary line. In this instance stockinette is pasted to cast by means of adhesive. Shell is painted with shellac and black enamel and reshellaced in order that it may be better observed in picture. Also, it prevents crumbling of surface. It has been suggested that cast should extend further down thighs. This has not been found necessary.

properly, is pulled over the shell "hind part before" and the patient place in it. The undershirt covering is especially desirable since it may be changed for another as occasions arise. One should not try to put the undershirt on the patient instead of the shell for it will wrinkle in spite of all that can be done and no patient can stand wrinkles in this type of shell.

During the time required for the plaster to dry the patient is kept in bed in the hyperflexed position with the Buck's extension in force to keep him from moving about or flexing his knees. He is given morphine sulphate grain ¼ or pantopon grain ⅓ hypodermically every four to six hours to control intestinal peristalsis and muscular contractions. If the narcotic order is written "P.R.N." the nurses will not give it until the patient becomes very restless, either from gas pains or muscle spasm. This, of course, is not desired.

The patient is kept in the shell continuously for a week, not being allowed to turn over or move about. He is so comfortable usually that he doesn't want to be disturbed. The Buck's extension is removed, of course, when he is placed in the shell, after he has been placed in the cast, though he is usually kept in the hospital for at least forty-eight hours after the shell is applied.

AFTER-TREATMENT

After the first week or ten days, providing there are no other injuries to interfere, the patient may be turned over on his abdomen with pillows placed under his hips and chest in such a manner as to maintain approximately the position in the shell. To do this properly he should be strapped in the shell with web belting about his hips and chest to insure maintenance of position until the maneuver is completed. Then the shell is simply lifted off. A good alcohol rub is given him after which his back is powdered and the shell replaced, after a clean covering has been put upon it. Then the straps are tightened and the patient rolled back into the shell. This is done daily two or three times if the patient desires it. There need be no fear of additional injury if the procedure is carried out properly.

Inasmuch as these patients are seldom injured otherwise they find lying in bed especially irksome, therefore anything that

will relieve the monotony is a welcome adjunct in the after-treatment. Daily exercises seem to be the best diversion. After the first two weeks in the shell a method of leg and arm exercises should be provided for them. The simplest method is the use of two long narrow pieces of rubber, cut from an inner-tube, one end of each attached to a bed post, at the head of the bed, and the other end of each tied so as to form a stirrup for either foot. With these the patient can walk, run or pedal a bicycle. The strength of the "pull" may be gauged by the width of the rubber strip. The same, or shorter strips, may be used for exercising the arm and shoulder muscles. Very little atrophy should exist when the treatment has been completed.

From eight to twelve weeks is usually sufficient for immobilization. When this period is over the patient should be provided with some sort of brace for his back that will prevent forward bending. I have discarded the use of heavy steel and the celluloid moulded braces, which are designed with a view to taking the body weight off the injured vertebra by transmitting the weight through the brace from the hips to the shoulders, because they are most uncomfortable, very expensive and fall short about 100 per cent of what they are designed to do, except to prevent forward, backward or lateral bending. Instead an ordinary corset type of brace with two thin strips of steel, the thickness and width depending upon the size of the patient, fitted to either side of the mid-line is used. It is comfortable, light and thoroughly efficient. Moreover, its cost is from 12 to 15 dollars against from 50 to 75 dollars for the elaborate steel braces. After all, all that is necessary is to prevent bending of the back. From four to eight months are usually sufficient for this type of immobilization.

A patient who has suffered even a first degree compression fracture should not attempt to perform manual labor for from twelve to eighteen months after the date of injury.

CONTRAINDICATIONS

The contraindications for this type of treatment, especially the "hammering-out" process, are: acute shock; when fractures of spinous process, or when fractures in any part of the neural arch co-exist; when fractures of one or both femurs or the pelvis co-exist; when multiple fractures of the ribs with marked displacement or puncture of the pleural cavity co-exist; acute brain injury; and, of course, when the cord is involved. Fractures of the transverse processes and one or two ribs make no difference.

This type of reduction and immobilization may be done at any time within the first ten days, with assurance that it can be successfully accomplished, but preferably within the first forty-eight hours. In this respect the management of this type of fracture is not unlike that of any other fracture when circumstances prevent early treatment of the particular injury.

ADVANTAGES

The advantages of early attempt at reduction are, of course, very obvious.

The advantages of this shell as an immobilization measure over the hyperextension frames, enveloping casts, etc. are:

1. It maintains the corrected and corrective position positively.
2. It fits the patient absolutely and is therefore comfortable.
3. It is strong, sturdy and durable. When properly made it will withstand 400 lb. of weight across its middle, when placed as the patient lies in it.
4. It allows for care of the skin and muscles of the back and for leg and arm exercises, thus preventing cast burns, cast abrasions and decubitus ulcers.
5. It is inexpensive and easy to make.
6. It allows the patient to return home from five to eight weeks earlier than other hyperextension methods.
7. It insures safety in transportation of the patient.

8. It allows clinical and *x*-ray study of the patient at any time throughout the treatment.

9. Obesity is no bar to its use.

10. It reduces nursing care to a minimum.

COMPLICATIONS

Such complications as hypostasis of the lungs, kidneys, bladder and liver are of great consequence to the surgeon in the management and treatment of any fracture which keeps the patient flat on his back for any considerable period of time. The method herein described reduces the probability of these complications to a minimum because the patient may be moved about rather frequently, and without danger. Only one of my series developed pneumonia and she died on the fifth day. She was thirty-two years old and had a severe bronchitis when she entered the hospital.

SUMMARY

1. A classification of compression fractures felicitates discussion and one is here presented.

2. Of the two manners of reduction of compression fractures of the internal bodies the rapid is preferred to the slow.

3. A new method of rapid reduction involving the use of a hammer and sand bag is presented.

4. Dissection shows that these fractures are not commonly impacted.

5. The after-care is best started in a plaster shell properly molded to fit the individual patient.

6. Caution should be exercised in allowing return to work.

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*Continued from p. 403.

PYELOGRAPHIC INJECTION OF THE PERIRENAL LYMPHATICS

REPORT OF 2 CASES AND REVIEW OF THE LITERATURE*

A CONSIDERATION OF THE RELATION OF PYELOLYMPHATIC BACKFLOW TO CHYLURIA, THE ANATOMY OF THE LYMPHATICS OF THE KIDNEY AND THE MECHANISM OF BACKFLOW FROM THE RENAL PARENCHYMA AND PELVIS

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INJECTION of the perirenal lymphatics during retrograde pyelography, the so-called "pyelolymphatic backflow," is one of the rarest and most intriguing phenomena encountered in urology. The decided paucity of case reports of this condition justifies the report of 2 additional cases, for it is only by careful detailed clinical and pyelographic studies of such cases that an exact anatomical, physiological and pathological explanation for this phenomenon can be determined and the relation of nonparasitic chyluria to pyelolymphatic backflow be established.

In a recent excellent article on nonparasitic chyluria and its relation to injection of the perirenal lymphatics, Wesson reviewed 6 cases (3 personal and 3 from literature) in which injection of the perirenal lymphatics occurred during routine pyelography. He cited 2 additional cases (Hampton and Eisendrath) which were not included since no pyelograms were published with the reports of these cases. In the discussion of Wesson's article, Gibson reported a case and cited the following additional cases: Casper and Picard, Konig*, Lozzi, and Lenardo and Alfonso de la Pena (2 cases). The illustration in the case reported by Casper and Picard apparently is the same as that reported by Eisendrath and hence this case is not included in the compilation of cases. Another case of pyelolymphatic backflow was reported by Boeminghaus and Hendriock. In 1933 Yamanouchi reported several cases of pyelolymphatic backflow observed in hematochyluria and in normal kidneys. The author has been unable to obtain further data on these cases due to the inability to obtain a translation of these articles and hence these cases are not listed in the series of cases collected and reviewed by the author. (See Table 1.)

Injection of the perirenal lymphatics was first observed and reported by Hampton* in 1920. In the discussion of the pyelographic findings in his case of hematochyluria, Hampton stated that there were very small tortuous shadows leading off from the tips of the calyces into the renal cortex. Unfortunately these shadows were rather indistinct and could be seen only in

* The author has been unable to obtain Konig's "Textbook of Pyelography" to verify his case report. A review of the various recent publications by Konig was undertaken and the report of the following case is cited as being suggestive of pyelolymphatic backflow: female, fifty-three years old, was treated for right nephroptosis and pyelitis. Pyelography with umbrenal was followed by severe pain. Pyelogram showed small irregular band-like shadows extending from the tips of the superior and inferior calyces which are suggestive of pyelolymphatic backflow. However, the author interpreted them as evidences of a pyelovenous backflow. This case is not included in the series of cases collected by the author).

* My senior colleague, Dr. A. E. Goldstein, had the opportunity of examining the original negatives in Hampton's case and states that the pyelographic findings were unquestionably those of injected perirenal lymphatics.

* From the Urological Clinic, Sinai Hospital, Baltimore, Md.

TABLE I
SUMMARY OF REPORTED CASES

Author	*Year*	*Age*	*Sex*	*Kidney*	*Chyluria*	*Chief Complaint*	*Method of Pyelography*	*Pyelographic Connections*	*Diagnosis*	*Remarks*
1. Hampton....	1920	23	F	right	yes	milky urine	not stated	tips of calyces	nonparasitic haematochyluria (rt)	Pelvis was dilated. Pyelolymphatic shadows were indistinct and could only be seen on negative. No parasites found
2. Wood.....	1929	70	M	left	yes	milky urine	not stated —15% NaI	pelvis	unilateral (lt) renal chyluria	Noticed milky urine at age of 21 and again 5 wks. before admission. Examination negative. Cystoscopy after heavy meal disclosed positive findings. Chyluria marked when in erect position, disappeared while in bed. After pyelography chyluria ceased
3. Boeminghaus and Hendriock.	1929	24	M	right	no	right renal coli	syringe pressure (?)	pelvis and minor calyces at level of fornices	pylelolymphatic backflow. Right ureteral stone	No mention made of chyluria. Pyelogram taken after injecting 5 cc. umbrenal showed pyelolymphatic backflow, caused severe pain. A roentgenogram taken 15 minutes later, no backflow and pain disappeared. Passed stone morning after pyelography
4. Eisendrath...	1930	..	..	left	no	hematuria	not stated	superior and middle calyx	left perirenal lymphatics	Stated that he observed same phenomenon in patient examined for hematuria which was localized on left side. No excessive pressure or volume of medium used. He suspected tuberculosis. No mention of chyluria tests. States that pyelographic finding was duplicate of Fillis
5. Fillis.....	1930	36	M	left	no	hematuria	syringe pressure	superior and middle calyx	left perirenal lymphatics	Hematuria due to stone in right kidney. Suffered excruciating pain for many days after pyelography. Pyelographic injection made very slowly. No test for chyle in urine as same not suspected. Subsequent pyelogram negative. Hydronephrosis with soft calculus on right side. Patient died following right nephrotomy. No autopsy
6. Lozzi.....	1931	28	M	right	yes	right lumbar pain and milky urine	syringe pressure (?)	superior calyx and tips of calyces and between calyces	unilateral (rt) renal chyluria due to filaria. Pyelolymphatic backflow	Milky urine from right ureter at cystoscopy; left ureter occluded; no urine obtained. Light pressure used at time of pyelography. Hematochyluria disappeared for 6 days after pyelography. Filaria bancrofti in urine and blood. Treated conservatively with quinine, chloroform water and chloroform narcosis with no results. Lumbar exploratory per-

Table 1 (*Continued*)

Author	*Year*	*Age*	*Sex*	*Kidney*	*Chyluria*	*Chief Complaint*	*Method of Pyelography*	*Pyelographic Connections*	*Diagnosis*	*Remarks*
										formed and large lymph trunks, found around ureter and pelvis passing toward vena cava and aorta, were removed. Chyluria disappeared for 5 days. Second operation to expose entire ureter with no benefit. Chyluria persisted
7. Exley.....	1933	39	M	left	no	left renal colic	syringe pressure	pelvis	left perirenal lymphatics	Patient passed stone from left kidney after ureteral dilatations 3 years ago. Cystoscopy negative. Stereoscopic pyelograms positive. No undue pressure used. No post-pyelographic pain
8. Gibson.....	1933	24	M	left	no	right renal colic	not stated	pelvis	left pyelolymphatic backflow	No symptoms referable to left kidney. Chyluria not demonstrated
9. Wesson..... Case I	1933	31	M	right	yes (?)	hematuria	18 inch gravity—13½% NaI	superior calyx	chyluria (?). right renal lymphatics	Patient noticed milky urine on frequent occasions but refused to submit to further examination to prove the presence of chyluria. Incorrectly diagnosed as tuberculosis by roentgenologist
10. Wesson..... Case II (Callander)	1933	58	F	left	yes	right lumbar pain	18 inch gravity-13½% NaI	superior calyx	chyluria with left perirenal lymphatic injection	Cystoscopy negative except for findings noted. Chyluria appeared after heavy fat meals. Intravenous pyelography 3 days later negative
11. Wesson.. .. Case III (Bonar)	1933	36	F	right	no	pain in right renal region	25 inch gravity—13½% NaI	superior calyx	right perirenal lymphatics in right ptotic kidney	Cystoscopy negative. Patient complained of metallic taste in mouth immediately after injecting NaI. Perirenal lymphatics noticed in flat and upright positions. Chyluria not demonstrated. Subsequent right pyelogram (retrograde) negative
12. Abeshouse... Case I	1934	45	M	right	no	pain in right lower quadrant	syringe pressure	inferior calyx	pyelolymphatic backflow	Repeated tests for chyluria negative. Chronic appendix removed after pyelography. No unusual findings in renal or ureteral regions found at operation
13. Abeshouse... Case II	1934	33	M	left	no	left renal colic	syringe pressure	superior calyx and pelvis	1. pyelolymphatic backflow 2. pyelovenous backflow 3. left ureteral stone, passed	Repeated tests for chyluria negative. Patient had right renal colic 2 months previously. Pyelographic study repeated one month later with negative findings

the negative and hence no photographs of the pyelograms accompanied the article. The first recorded graphic demonstration of injection of the perirenal lymphatics was made by Wood in 1928 in his report of a case of unilateral renal chyluria. It is possible that many more cases of injected perirenal lymphatics have been encountered by urologists but are not reported either because the true nature of the condition is not recognized or they are incorrectly diagnosed as calcification of the blood vessels or papillae, tuberculosis, etc.

LYMPHATICS OF THE KIDNEY

A brief review of the lymphatics of the kidney is in order before undertaking a discussion of the significance of injected perirenal lymphatics and its relations to chyluria. Our present knowledge of the lymphatics of the kidney and its fat capsule is the result of the painstaking anatomical investigations of Mascagni, Slappey, Poirier and Cuneo, Stahr, Kumita, Nicolesco, Rouviere and others. Rouviere has thoroughly reviewed the subject of the lymphatics of the kidney in his excellent monograph published in 1932 and it is from his work that most of the following data are taken.

The lymphatics of the kidney and its fat capsule may be conveniently divided into the following anatomical groups: (a) fat capsule, (*b*) fibrous capsule, (*c*) renal parenchyma, and (*d*) pelvis and calyces.

(a) *Lymphatics of the Fat Capsule:* The fat capsule of the kidney possesses a superficial and deep network of lymph vessels. The superficial network, which was first described by Stahr and later by Kumita and Ssysganow, is situated immediately under the peritoneum. The deep network is situated more deeply in the fat capsule and receives branches from the superficial network. The collecting trunks of these networks empty into the lymph glands found near the origin of the renal artery and the termination of the renal vein. On the right side, these glands are found between the vena cava and aorta below the renal vein. On the left side, these glands are included in the juxta-aortic group and are situated in front of or on the border of the aorta. Occasionally, one or more of these collecting trunks on either side may drain into a gland situated in the region of the inferior mesentery. The lymphatics of the fat capsule communicate with those of the neighboring peritoneum, diaphragm, and the juxta-aortic glands draining the testicles and ovaries. According to Rouviere the lymphatics of right fat capsule communicate with those of the cecum, appendix and ascending colon; but those of left fat capsules, do not communicate with those of the transverse or descending colon and sigmoid. Stahr and Kumita showed that lymph channels of the fatty and fibrous capsules, which communicate with the lymphatics of the renal cortex, can be injected from the capillary bed of the muscularis of the small intestines.

There are intercalary nodules in the path of the collecting trunks of the fat capsule. These nodules are usually found behind the kidney near the upper pole (posterior superior ganglion) and the lower pole (posterior inferior ganglion). Occasionally several small nodules are seen in the fat in the peripelvic region and on the anterior surface of the kidney.

(b) *Lymphatics of the Fibrous Capsule:* Mascagni was the first to describe a lymphatic network in the fibrous capsule. Later, Renault described a similar network in a dog' skidney and demonstrated a communication between this network and the lymphatics of the parenchyma. Stahr and Ssyganow confirmed these findings. The lymphatics of the true capsule are comprised of a tense network of lymph channels which are situated immediately beneath the fibrous capsule and are extremely difficult to inject. According to Slappey and Poirier and Cuneo there arises from this superficial network two sets of collecting trunks, i.e., a convergent and divergent group. The convergent trunks are connected with the deep collecting trunks of the kidney parenchyma, either by passing

into the depths of the parenchyma in the columns of Bertini or by passing under the capsule to join with the collecting trunks of the parenchyma as they emerge near the hilum of the kidney. The latter group of collecting trunks communicate with the lymphatics in the periureteral sheath. The divergent trunks appear to perforate the fibrous capsule to communicate with the lymphatics of the fat capsule. (Fig. 1.)

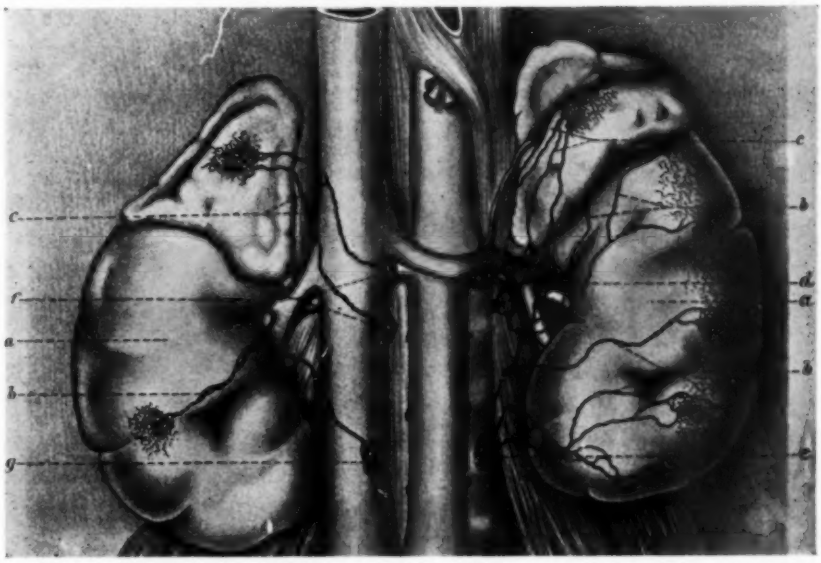

Fig. 1. Photograph of injected lymphatics of fibrous capsule of kidney and adrenal in a newborn male child (After Kumita.) *a*. Capsule of kidney. *b*. Collecting trunks from kidney. *c*. Collecting trunks from adrenal. *d*. Regional lymph nodes draining left kidney and left adrenal and situated on left border of abdominal aorta under left renal vein. *e*. Regional lymph nodes draining left kidney and situated on left side of abdominal aorta. *f*. Regional lymph nodes draining right adrenal and situated on medial border of inferior vena cava under left renal vein. *g*. Regional lymph nodes draining right kidney and situated on anterior surface of inferior vena cava.

(c) *Lymphatics of the Renal Parenchyma:* Rindowsky was the first to describe the presence of lymph capillaries in the renal parenchyma surrounding the glomeruli and tubules and was able to trace these capillaries into the glomeruli. These findings were confirmed by Kumita, Nicolesco, Rouviere and others. (Figs. 2, 3.) The lymph capillaries surrounding the glomeruli and the proximal and distal convoluted tubules in the cortical zone communicate with the plexus situated beneath the fibrous capsule and in turn with the lymphatics of the fat capsule as indicated above. In the medullary zone the lymph capillaries surround the loops of Henle, and the collecting tubules give rise to large collecting trunks which pass up to the base of the pyramids to unite with trunks from the cortical network. In the cortex and medulla the lymph capillaries run along parallel to the tubules which produces the striations in these zones.

Ssysganow studied the larger lymphatic vessels of the renal parenchyma and concluded that (a) they pass around the arteries and veins and their branches; (b) the perivenous network is more abundant than the periarterial; and (c) the size of the periarterial and perivenous lymph trunks is in proportion to the caliber of the blood vessels. Rouviere states that the lymphatic vessels of the renal parenchyma, even the very large trunks, are devoid of valves.

The intrarenal course of the main collecting trunks of the renal parenchyma have been well described by Stahr, Poirier and Cuneo, Kumita, Ssysganow, Nicolesco and others. They have shown that these trunks from the cortical and medullary zones traverse the columns of Bertini to unite at the level of the base of the pyramids with other trunks from these areas. These lymphatic trunks accompany the larger

blood vessels as they pass along the base of the pyramids, surface of the calyces, and the intrarenal or intrasinusal portion of the

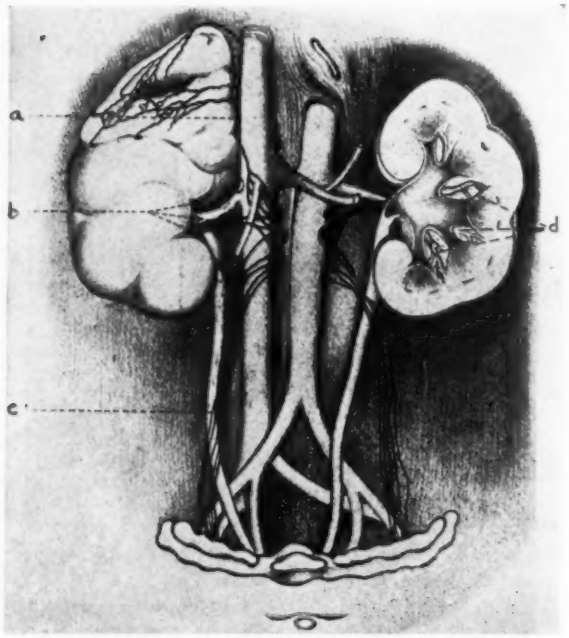

Fig. 2. Photograph of injected lymphatics of adrenal capsule and renal parenchyma in newborn male child. (After Kumita.) *a*. Collecting trunks from adrenal capsule. *b*. Efferent lymph trunks from renal parenchyma. *c*. Collecting trunks from ovaries. *d*. Lymphatic vessels in medullary portion of kidney.

pelvis and finally reach the hilum where they pass along with the other elements of the pedicle.

Outside the kidney, these collecting trunks are divided into three groups: i.e., anterior, median and posterior, according to whether they are situated in front of, between or behind the vena cava and aorta. The extrarenal course and termination of these collecting trunks differ on each side.

On the right side, the anterior trunks, three to four in number, drain the anterior part of the kidney. They pass along the anterior surface of the prepelvic artery and renal vein. They course in front or behind the vena cava to terminate in the right lateral (juxta) aortic lymph nodes which are found along the aorta extending from the renal artery to the inferior mesentery. Often one trunk passes to a node situated immediately beneath the termination of the renal vein. Occasionally, a trunk passes to a node situated in front of the vena cava. The posterior trunks, three to five in number, normally drain the posterior part

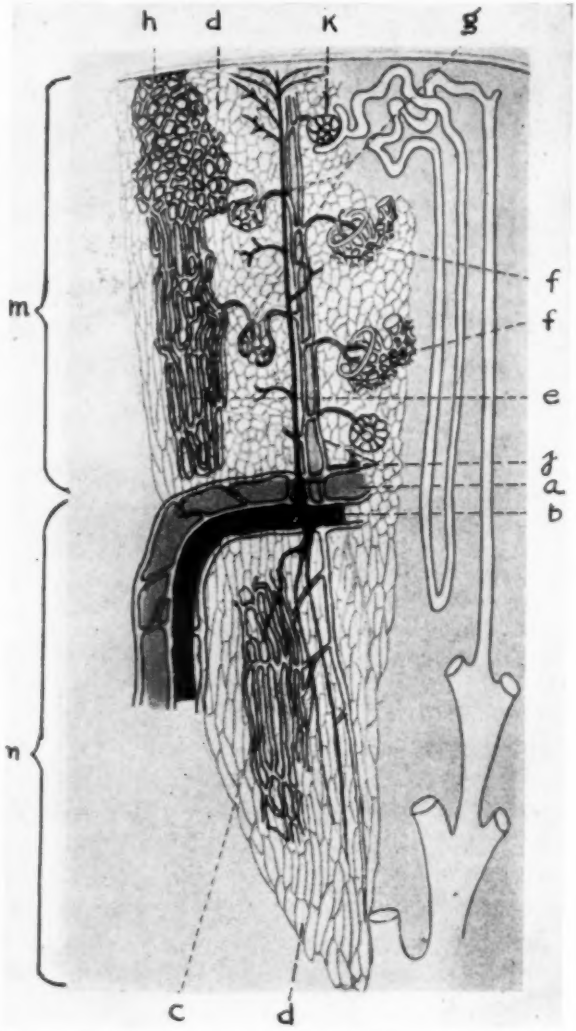

Fig. 3. Schematic diagram of uriniferous tubule (right side) and vascular and lymphatic systems (left side) of kidney. (After Kumita.) *a*. Artery. *b*. Vein. *c*. Lymphatic network around collecting tubules (dark color). *d*. Blood capillary network of renal parenchyma (light color). *e*. Lymphatic network around loops of Henle. *f*. Pericapsular lymph capillaries. *g*. Intracapsular lymph capillaries. *h*. Lymphatic network around convoluted tubules. *i*. Perivascular lymphatic network. *j*. Glomerular tuft.

of the kidney. They accompany the branches of the retropelvic artery and pass along the posterior surface of the renal artery to terminate in three or four of the retrovenous group of right juxta-aortic nodes which are situated on the right pillar of the diaphragm, behind the vena cava,

and along the right border of the aorta between the renal artery and the origin of the inferior mesentery. The median trunks, one or two in number, pass between the renal artery and vein to terminate in the right juxta-aortic lymph nodes. Occasionally intercalary nodules or ganglions (*schaldrusen*) are interposed in the course of the lymph trunks from the kidney to the juxta-aortic nodes. From the juxta-aortic nodes, efferent lymph vessels pass through an opening in the right pillar of the diaphragm, containing the great splanchnic nerve, to terminate in the thoracic duct.

On the left side, the anterior trunks, three or four in number, pass in front of the renal vein to terminate in the juxta-aortic lymph nodes in front of the renal vein. The trunks draining the upper part of the kidney may empty into a node situated in the angle formed by the junction of the renal and suprarenal veins. The trunk draining the inferior portion of the kidney may empty into a node situated at the junction of the left spermatic and left renal vein. The posterior collecting trunks, three to four in number as on the right side, are found coursing over the posterior aspect of the retropelvic artery and renal artery to reach the juxta-aortic nodes situated near the origin of the renal artery. The median trunks are rarely more than one or two in number and terminate in a node situated above the junction of the left renal and suprarenal vein or in a pre-aortic node. The group of juxta-aortic nodes draining the left kidney is made up of five to six nodes overlying the left border of the abdominal aorta. The uppermost gland of this group is situated in front of the left pillar of diaphragm which is traversed by efferent lymph vessels from this group as they pass up to join the thoracic duct.

(d) *Lymphatics of the Pelvis and Calyces:* Nicolesco studied the lymphatics of these structures in 65 preparations. His findings were confirmed by Ssysganow. The lymphatics of pelves and calyces consist of a network of fine elongated vessels found in the submucosa. They are in communication with the lymphatics of the upper portion of the ureter. They give rise to collecting trunks which accompany the larger blood vessels in the pedicle, particularly the artery. Outside the kidney these collecting trunks, which vary in number from two to four, anastomose and pass up to nodes situated on the psoas muscle and on the pillars of the diaphragm below the origin of the renal artery. Nicolesco states that in the majority of cases an intercalary nodule may be found in the course of one of the collecting trunks passing along the superior surface of the renal artery, at a point opposite the junction of renal vein and suprarenal vein or the junction of the renal and spermatic vein.

ETIOLOGY OF CHYLURIA

The role of the lymphatics of the kidney in the production of chyluria is extremely important but by no means clearly established in every case. There are many cases of chyluria reported in the literature where this condition is the result of lymphatic obstruction caused by Filaria sanquinis hominis. This type is called tropical, parasitic or filarial chyluria. Occasional cases of parasitic chyluria are recorded in which the causative agent was a parasite other than Filaria bancrofti, namely, Taenia nana, Eustrongylus gigas, Cercomonas hominis, and the malarial parasite. The other less frequent type is called nonparasitic or European chyluria or chyluria nostras. The etiological and mechanical factors concerned in the production of nonparasitic chyluria is as yet undetermined.

Several theories have been offered to explain the presence of chyle in the urine. The proponents of the secretory theory hold that under certain abnormal conditions of the renal epithelium, chyle is secreted directly from the blood into the urine through the renal epithelium. They assumed that a constitutional anomaly existed, i.e., chylous blood condition, lowered threshold substance exchange and a pathological filtering through the kidney. The demonstration of fat globules in the

renal epithelium, which is noted more frequently in lipuria associated with chronic diffuse nephritis than in true chyluria, does not suffice to explain the chyluria since fat globules may be found in the renal epithelium in diverse conditions without a co-existing chyluria or lipuria. The fact that the chyluria may be acute, chronic or intermittent, unilateral or bilateral, or may be influenced by posture, exercise and ingestion of fatty meals would tend to disprove this theory.

The theory that is universally accepted as an explanation for the presence of chyle in the urine was first advanced by Carter in 1862 and by Ackerman in 1863. The latter maintained that the cause of chyle in the urine is a fistulous communication between the lymphatic and urinary systems which is the result of a lymphatic obstruction occurring at some point between the collecting trunks of the small intestines and the termination of the thoracic duct. In the presence of such an obstruction, stasis and dilatation of the lymph vessels occurs peripherally with the result that the chyle is forced from the intestinal lacteals in a retrograde direction toward the pelvis. From this area, the lymph stream is diverted back through the lymphatics of the abdominal wall which anastomose with those of the upper half of the body and in turn empty into the thoracic duct or right lymphatic duct. Under these conditions rupture of one or more lymphatic vessels may occur at any point in this collateral circulation with a resultant chylous ascites, chylocele, or chyluria. In this connection, it has been pointed out by Warthin, and later by Lower and Belcher, and by Wesson, that chyluria takes place in the presence of thoracic duct obstruction only when the collateral lymphatic circulation is inadequate. The adequacy of the latter is suggested by the frequent occurrence of potentially obstructive lesions of the thoracic duct, i.e., tuberculosis of the mediastinal lymph nodes, mediastinal tumors, thoracic aneurysms, etc., as compared with the rare occurrence of chyluria. The importance of a break in the collateral circulation of the lymph and its role in the development of a chyluria is emphasized by the recorded cases of cancer in which dilatation and stasis of the thoracic duct occurred but death ensued before the lymph circulation failed. However, it is possible, as indicated by authentic case reports, that obstruction of the thoracic duct or intestinal collecting trunks can be caused by the pressure of mediastinal or intra-abdominal tumors, infectious or neoplastic enlargement of the retroperitoneal or mediastinal lymph nodes, tuberculosis of these glands (Port), perirenal infections (Klutzman), pregnant uterus (Davis), etc. with the formation of a fistulous communication between the lymphatic and urinary systems. An old abscess is suggested as the cause of the chyluria in the case reported by Harrison who observed a fistula opening into the bladder on cystoscopy and dilated lymphatics at operation. McKenna reviewed the literature from 1889 to 1924 and quotes 2 cases of chyluria in patients with tuberculosis of the spine, one of which showed dilated lymphatics near the kidney on postmortem examination. He also suggested that, in addition to tuberculosis, occlusion or obstruction of the thoracic duct may be due to a local abscess or to trauma.

Hampton believed that the lymphatics of the kidney represented the point of lowest resistance in the lymphatic system. He maintained that in the presence of an obstruction of the thoracic duct or of the large trunks leading from the kidneys, a rupture of the lymphatics of the kidney occurs in a manner comparable to a rupture of an esophageal varix in cases of portal obstruction or a rupture of a cerebral artery in cases of hypertension. Hampton concluded that the chyluria was the result of rupture of the deep lymphatics of the kidney into the tubules or directly into the calyces.

Chyluria is characterized by the presence of chyle or lymphatic contents in the urine

which imparts an opaque white color closely resembling milk. The turbidity is due to the minute granules of fat which are in granular form as seen under the microscope. In cases of hematochyluria, a pinkish tint is imparted by the presence of red blood cells. The fats are present as an emulsion or as mixtures of fatty acids, neutral fats and soaps.

The fat can be separated from the emulsion by etherization and the exact amount can be determined by the Babcock test. The urine is usually acid and low in specific gravity. The protein content is increased. Those cases of chyluria associated with an extremely small urinary fat output are occasionally referred to as lymphuria. Chyluria must be differentiated from lipuria and pyuria. In lipuria the fat is present as such in the urine and appears in little globules or droplets which are readily discernible with the naked eye and under the microscope and can be stained with the various stains for fats. Pyuria can be excluded by microscopic examination.

Every case of injected perirenal lymphatics should be carefully studied for chyluria. The examiner should always bear in mind that chyluria may present some interesting variations as regards the time and duration of its appearance. It may bear a peculiar relationship to the time of day inasmuch as in some cases it is present at all times, whereas in others it may appear only in the day or night urines. It may be either continuous or intermittent, occurring only a few weeks out of the year or reappearing after a lapse of several years. It may appear without any demonstrable cause or it may follow any strenuous exercise or heavy work. It may make a sudden appearance following the ingestion of a meal rich in fats. Posture may exert a considerable influence on the active secretion of a chylous urine. Frequently the chyle is found in the urine when the patient is erect, either standing or sitting, and disappears when the patient assumes a recumbent position. The reverse may be true in an occasional case where chyle is observed in the urine while the patient is lying down and disappears when the patient adopts an upright position and becomes active. A possible explanation of the variation of chyluria with postural changes may be found in the fact that the chyluria may be the result of the intermittent compression or obstruction of the thoracic duct or the connecting lymphatics by some factor or lesion which is operative only when the patient assumes certain attitudes.

In cases of injected perirenal lymphatics, examination for chyluria should not be limited to a study of the admission specimen of urine, which is usually a voided specimen, or to a catheterized specimen obtained routinely or to urine specimens obtained at a single cystoscopy by ureteral catheterization. It should be repeated at frequent intervals, preferably obtaining catheterized specimens of urine. Day and night specimens should be collected separately. Specimens should also be obtained before and after meals, particularly test meals containing an increased amount of fat. Wesson recommends giving two glasses of equal parts of milk and cream and obtaining a catheterized specimen of urine at the end of one hour and again after four hours have elapsed. He states that if the test is negative, it should be repeated with the patient in the recumbent position. Hampton placed his patient on the usual hospital diet with an extra amount of butter and gave two glasses of milk before each test. Catheterization of the kidneys was carried out every hour for four hours. In his case, chyle was present in large amounts in the first hour specimen and had practically disappeared in the last collection.

PATHOLOGY OF CHYLURIA

Chyle may enter the urine from the kidney, ureter or bladder. In the rare cases of chyluria associated with filariasis of the scrotal lymphatics it may enter through the vas deferens into the urethra (Hartman

and Keppel). The chyluria may be unilateral or bilateral if the upper urinary tract is involved. The point of entry of the chyle may vary in the same patient at different times or there may be more than one fistulous opening in the same patient at the same time. In the majority of cases the source of the chyluria can be readily detected by cystoscopy. Cystoscopy proved to be an invaluable aid in discerning the presence of chyle escaping from one or both ureters in the cases of Franz and Stepal (1902), Stuertz (1903), Sanes and Kahn (1916), Sandston (1918), Hampton (1920), Welfield (1924), Lower and Belcher (1924), Kutzman (1925), and Lozzi (1932). The vesical origin of chyle was demonstrated on cystoscopy by Ludke (1908), Pope (1909), Bloch (1913), and Harrison (1930). In his case of non-parasitic chyluria, Ludke observed that the urine emerging from the ureters was clear and became milky in the bladder. He attributed the chyluria to a colon bacillus infection of the bladder. Pope found a chylous fistula in the trigone of the bladder. Bloch found a white dome-like structure in the bladder above the right ureteral orifice with a small opening from which chyle escaped. After cauterization the chyluria disappeared.

The fistulous communication between the lymphatic and urinary systems has been demonstrated in several cases of parasitic chyluria by autopsy, operation or cystoscopy. The essential pathological features of this condition is the rupture of the lymphatics which may be the result of (a) an obstruction of the thoracic duct by the larvae, or (b) an obstruction of main duct or its tributaries by such secondary inflammatory changes as stricture or calculi due to the presence of the parasites, or (c) the development of false passages created by the burrowing of the larvae.

Many important post-mortem studies have been made in cases of parasitic chyluria which clearly demonstrate the influence of the pathological changes in the lymphatics in the upper part of the body upon the circulation of the chyle and its subsequent sudden appearance in the urine. The findings in several of the outstanding and representative cases of this type of chyluria are cited here.

In 1882 Mackenzie reported a case of parasitic chyluria associated with repeated attacks of left renal colic. The parasites were found in the blood and urine. At autopsy, an occlusion of the thoracic duct was found, where it passed through a mass of inflammatory material. There was a marked enlargement of iliac, lumbar and renal lymphatics. Scattered through the left renal lymphatics were numerous hard round masses (calculi), some the size of a pea but mostly smaller. In the same year Havelburg reported a case of filarial chyluria in which autopsy revealed a large multilocular dilated lymph sac extending from the left kidney to the bladder where its attachment was sieve-like and exuded lymph. In 1903, Stuertz performed a left nephrectomy in a case of parasitic chyluria and in the removed kidney found the Eustrongylus gigas which he believed was responsible for the chyluria. The chyluria persisted after the operation. In Lozzi's case of unilateral parasitic chyluria, there was found at operation several large lymphatic trunks surrounding the ureter and renal pelvis and extending in the direction of the vena cava and aorta. The trunks were removed together with a lymph gland which was the size of a pea and was situated in the course of these trunks. The urine remained clear for five days after operation and then the chyluria returned. At a second operation the entire ureter down to the bladder was exposed with no result and the chyluria persisted.

Little conclusive information concerning the pathology and mechanism of lymphatic changes in cases of non-parasitic chyluria can be gathered from a review of the few autopsy and operative records of this type of chyluria. It is generally agreed that non-parasitic chyluria rests upon a pathologic affection of the lymphatics involving (a) mechanical obstruction of the thoracic duct, (b) an insufficiency of the collateral

lymph circulation, (c) dilatation and stasis of the peripheral lymph channels, or (d) rupture of lymphatic into the urinary tract with the development of a chyluria. Authentic anatomical or pathological proof in support of this theory is very frequently lacking since the exact point of communication between the lymphatic and urinary systems can be demonstrated with extreme difficulty, if at all, in the post-mortem studies of these cases. This may be explained by the fact that, firstly, anatomical demonstration of lymph vessels changes is always extremely difficult, and, secondly, the lymphatics in these cases may be dilated and engorged during life but are collapsed and invisible after death. It is unfortunate that relatively few cases of non-parasitic chyluria have been subjected to dissection or post-mortem study for it is only by careful and detailed anatomic and histologic study of the lymphatics in these cases that the uncertainty attending the etiology and mechanism of the chyluria will be cleared.

Kutzman, and Hamer and Mertz have pointed out that non-parasitic chyluria may be associated with various conditions or diseases. In certain cases, the relationship is that of cause and effect, in others the co-existence is merely coincidental. Chyluria has been repeatedly observed in pregnancy and in the early days of lactation. Several cases are reported in which the chyluria occurred in a diabetic patient. Chyluria has been found to occur during the course of an infectious or suppurative disease, i.e., diphtheria, pneumonia, tuberculosis, syphilis, malaria, colon bacillus infection of the urinary tract, and perirenal abscess. Some of the obstructive lesions which may produce a blockage of the thoracic duct with a resultant insufficiency of the collateral lymph circulation and subsequent rupture of the lymphatics of the urinary tract with discharge of chyle into the urine, are neoplastic and infectious diseases of the throracic, mediastinal and retroperitoneal lymph nodes.

Chyluria may have a traumatic basis. Hunt reported a case in which the patient fell from a height of about 10 feet and struck a heap of stones. It is most likely that a lymphatic vessel ruptured at some point in the urinary tract and healed spontaneously as the chyluria occurred only in one micturition.

Ponfick was the first to demonstrate by autopsy of fistulous communication between the lymphatic and urinary systems. A large dilated lymph sac was found extending from the kidney to the bladder. In 1906, Port found large caseating medistinal lymph glands obstructing the thoaracic duct in a case of non-parasitic chyluria but was unable to find any communication with the urinary system. He attributed the chyluria to a leakage of chyle into the pelvis of both kidneys. In the case reported by Hertz in 1907, autopsy showed an obstruction in the thoracic duct which led to a dilatation of the abdominal lymphatics with a reflex of chyle from the intestines to the right side of the bladder. The chyluria had ceased some time before death, consequently the fistulous communication between the bladder lymphatics and the bladder had been closed over. In 1911, Low found dilated lymphatics in both the kidneys and the bladder and thought that these findings were responsible for the leakage. He considered his case as a lymphuria rather than a chyluria as the amount of fat present in the urine was almost nil. In 1916 Sanes and Kahn reported a case of bilateral renal chyluria in which every attempt to determine the etiology was negative. Exploratory operation failed to reveal anything abnormal in the kidney or the surrounding viscera. They concluded that the chyluria was non-parasitic and renal origin and attributed the chyluria to the direct passage into the urine of fat from the blood through the renal epithelium, probably as the result of a functional disturbance of the renal epithelium. In 1925 Kutzman reported a case of non-parasitic chyluria associated with a left perirenal abscess which communicated with the

renal pelvis through the superior calyx. The chyluria disappeared after nephrectomy.

MECHANISM OF BACKFLOW FROM THE RENAL PELVIS

The anatomical and physiological aspects of the mechanisms of backflow and absorption from the renal pelvis have been the subject of much study and some controversy. Since the noteworthy contribution of Hinman and Lee-Brown in 1924 on pyelovenous backflow, numerous publications have appeared on this same subject and its associated problems by such important contributors as Fuchs, Morison, Moise and Bird, Boeminghaus, de la Pena, Lozzi, Vitale, Sacco and others. Prior to Hinman and Lee-Brown's work, pyelovenous backflow had been noticed by several observers. In 1856 Gigon concluded from his studies on cadavers and living animals that the overflow of fluid from the kidney pelvis into the venous system takes place through the venous plexuses. In 1863 Zaworykin and Ludwig demonstrated that the overflow into the venous system occurred through a small rupture of the mucous membrane of the kidney pelvis. In 1891 Poirier also demonstrated pyelovenous backflow following the injection of the ureter in cadavers. In 1897 Lewin and Goldschmidt observed the passage of air from the bladder through the ureter to the kidney pelvis and into the venous plexuses and the vena cava following the inflation of air of the bladder of a narcotized rabbit. Lewin (1898) and Marcus (1903), who repeated Lewin's experiments, also observed pyelovenous backflow. Lewin maintained that there were natural communications between the renal pelvis and the venous system and argued against a traumatic communication resulting from a rupture. These views have not been substantiated or verified by subsequent investigators. Marcus was the first to correctly attribute the penetration into the venous system to the development of minute tears in the pelvis in the region of calyceal fornices.

Experimental studies have shown that the mechanism of backflow from the renal pelvis may be divided into the following types: (1) pyelovenous backflow (Hinman and associates, Fuchs and others); (2) pyelotubular backflow (Lewin, Bird and Moise); (3) pyeloparenchymatous backflow (Keyes and Mason, Blum, Oehlecker); and (4) pyelolymphatic backflow (Lewin, Marcus, Morison, Vitale, Lozzi). The first three types have been proved beyond a doubt by the various experimental studies whereas the existence of the pyelolymphatic type has been questioned by many of the investigators.

Pyelovenous Backflow: In 1924 Hinman and Lee-Brown conclusively demonstrated the direct passage of fluid from the renal pelvis into the venous system following ureteral injection of the kidneys of dead sheep and rabbits. They found that pelvic distention, at minimal and secretory pressures, produces innumerable points of communication in the form of minute ruptures which occurred in the deep sulci (fornices) of the minor calyces where the rich plexuses of the venulae rectae are in very close apposition to the calyceal mucous membrane. These observations have been further confirmed by studies on the kidneys of living and dead animals and human cadavers by Fuchs, Lozzi, Sacco and others.

In addition, Fuchs has pointed out that in the normal or hypertrophied kidney pyelovenous backflow is more likely to occur than pyelotubular backflow because of the acute angle formed by the papilla and the calyx; whereas the reverse is true in hydronephrosis where this angle is widened and the collecting tubules are dilated.

The pyelographic picture of pyelovenous backflow is a radiation into the cortex which first appears as a cone or funnel deformity from the base of the pyramids. If the injection pressure is increased, the pyelogram may show an arching in the region of the base of the pyramids which is due to a filling of the anastomic venous arches. Radiations may then extend into

the cortex as the result of the filling of the interlobular veins.

Pyelotubular Backflow: In 1898, Lewin studied the effect of injection of suspensions of ultramarine, diatoms and air into the ureter of narcotized rabbits and found that the three small canal systems of the kidneys, i.e., uriniferous tubules, lymph spaces and blood vessels, were nearly always filled with the injected mass but not to the same extent. He found that the uriniferous tubules were sometimes filled, but the venous system and the lymph spaces more frequently so. These experiments were repeated by Marcus in 1903 who came to the same conclusions but differed as to the mechanics of penetration.

Bird and Moise, working on living dogs, succeeded in forcing fluids from the kidney pelvis into the uriniferous tubules by a gradual increase in pressure. They were unable to demonstrate any pyelovenous backflow and maintained that if a pyelovenous backflow did occur in living animals, the probable mechanism is by rupture of the tubules into the large straight and accurate veins.

Hinman has pointed out that the roentgenographic picture of pyelotubular backflow is a short brush-like radiation from the tips of the papilla into the medulla for a short distance. Radiation into the cortex along the interlobular veins into the cortex never occurs with pyelotubular backflow.

Pyeloparenchymatous Backflow: Lewin was able to demonstrate a peritubular infiltration of the injection mass in his experiments. In 1915, Keyes and Mason obtained human kidneys at autopsy which had been severely damaged by collargol pyelography and found large and small masses of collargol scattered between the tubules. They also demonstrated the presence of collargol within the tubules, glomeruli, arteries and veins. In experiments on narcotized dogs, they never found collargol in the collecting tubules but only in the blood vessels, lymph spaces and the connective tissue around the urinary canals. Other investigators, working independently of Keyes and Mason, had previously reported that collargol injected into the kidney pelvis penetrated the interstitial connective tissue and lymph spaces and that this phenomenon was the result of rupture of the uriniferous tubules. In 1912 Blum found that collargol passed through ruptured collecting tubules. In 1913 Tennant noticed infiltration of the parenchyma by collargol. In 1914 Eisendrath described parenchymal infarcts following collargol pyelography.

It appears that under conditions of sudden and great pressure a direct extravasation of the pelvic contents may take place into the interstitial tissue, following the lines of least resistance and even extending to the subcapsular region. The pyelographic findings in cases of pyeloparenchymatous backflow may vary somewhat. The extravasated fluid usually assumes a blotchy and irregular appearance extending outward from the major or minor calyces. Occasionally the extravasation of the pyelographic medium into the interstitial tissue appears as a small thick band extending for a short distance into the kidney parenchyma.

Pyelolymphatic Backflow: There appears to be no unanimity of opinion as to the existence of this particular mechanism of backflow. In their experiments Lewin and Marcus showed that the lymph spaces and the venules were more frequently injected than the uriniferous tubules. Lewin maintained that the lymph spaces were more often filled than the other systems and explained the primary entrance of foreign substances from the pelvis into the lymph spaces on the effect of pathological pressures exerted directly on the so-called pelvic "lymph stomata." Anatomical and histological confirmation of the presence of these "lymph stomata," communicating directly with the pelvis, is lacking in the literature. Pyelolymphatic backflow has been observed in dogs and rabbits by Morison, Vitale and Lozzi. Lozzi observed this phenomenon twelve times in nineteen

experiments. Morison and Vitale maintained that pyelolymphatic backflow constitutes one of the principal paths of absorption in hydronephrosis. From his experiments on rabbits and dogs concerning the absorption of dyes introduced into the renal pelvis in hydronephrosis resulting from total occlusion of the ureter, Morison concluded that two routes of absorption are present, namely, lymphatic and tubular. He maintained that at the onset of complete ureteral obstruction, there ensues for the first two or three days a purely lymphatic absorption from the walls of the renal pelvis and ureter. After about the third day, tubular absorption commences and continues more actively than the lymphatic.

In 1932, Schmidt and Hayman made an important contribution to the physiology of the renal lymphatics. In their experiments on dogs they showed that diuretic agents uniformly increased the outflow of lymph, at the same time that the urine flow and renal blood flow were increased. They also showed by injection and perfusion experiments that there is no direct communication between the blood lymph vascular systems in the kidney. Their results showed that fluid can leave the blood within the kidney to enter the lymphatics as well as the ureter and that escape through both channels is augmented by the same agents, i.e., diuretics.

Experimental and clinical observations show that pyelolymphatic back-flow is rare in comparison with pyelovenous, pyelotubular and pyeloparenchymatous backflow. This is undoubtedly explained by the fact that under abnormal pressures the anatomical and physiological relations of the pelvis, tubules and venous system favor a mechanism of backflow other than the pyelolymphatic type. Furthermore, the fine caliber of lymph vessels of the parenchyma and pelvis does not permit penetration of injected fluid as do the other canalicular systems. The few case reports of pyelolymphatic backflow emphasize the fact that roentgenographic demonstration of the renal and perirenal lymphatics is extremely difficult.

An analysis of the 13 reported cases of injected perirenal lymphatics reveals that the left kidney was involved in 7 cases, the right kidney in 6 cases. In no case was the phenomenon observed in both kidneys in the same individual. There were 9 males and 3 females; the sex was not mentioned in one case. The youngest patient was twenty-three years old (Hampton); the oldest seventy years (Wood). The majority of the cases occurred in individuals in the third and fourth decades of life; 5 cases occurred in the fourth decade and 4 in the third decade.

Chyluria was observed in 5 of these cases, of which 4 were non-parasitic in type and the fifth (Lozzi's case) was of the parasitic type as demonstrated by the presence of Filaria bancrofti in the urine and blood. In 8 cases chyluria was either not present or mention of it was not made due to the fact that its presence was not suspected.

The pyelographic picture of injected perirenal lymphatics is rather characteristic and can easily be differentiated from pyelovenous, pyelotubular, and pyeloparenchymatous backflow. The injected lymphatics are usually depicted in the pyelograms as slightly irregular or tortuous striations extending directly from either the pelvis or calyces or both. Their general direction is from the hilum of the kidney toward the vertebral column. Occasionally, very narrow linear shadows are observed leading directly from the tips of the calyces or from the minor calyces at the level of the fornices. The latter type of injected lymphatics, which correspond to the lymphatics of the parenchyma, appears to extend into the cortex for a short distance and then to pass through the kidney to join the main collecting trunks of the renal parenchyma. The larger shadows representing the main collecting trunks of the renal parenchyma appear to emerge from the hilum of the

kidney and cross the pelvis to extend medially in the direction of the juxta-aortic lymph glands. The injected renal and perirenal lymphatics may be confused with calcification of the renal vessels. A plain roentgenogram taken before the pyelographic studies will serve to differentiate the true nature of these shadows in the latter instance.

In the series of 13 cases reviewed, the lymphatics appeared to connect directly with the pelvis in 5 cases. In the remaining cases, they were connected with the calyces; the superior calyx in 5 cases, middle calyx (together with superior calyx) in 2 cases; inferior calyx in one case; tips of minor calyces (major calyx not determined) in 3 cases.

The relation of non-parasitic chyluria to injection of the perirenal lymphatics is an extremely interesting, though muted question. Hampton was the first to recognize the significance of injection of the perirenal lymphatics and believed that they indicated the exact point of communication between the lymphatic and urinary systems. Wood came to the same conclusion from the pyelographic findings in his case. Wesson states that injection of the perirenal lymphatics by retrograde pyelography indicates an open pathway between the urinary tract and the lymphatic system and when such is present a state of cyhluria should exist. He is of the opinion that failure to demonstrate chyluria is the result of a break in diagnostic technique. He also pointed out that the converse is true, namely, that the exact point of communication between the lymphatics and the urinary systems can be demonstrated by retrograde pyelography in cases of chyluria, providing the operator has sufficient patience. He maintains that over-injection or excessive pressure in pyelography will not produce an injection of the perirenal lymphatics but that this phenomenon is the result of gentle flowing of the pyelographic medium into the enlarged open lymphatics.

Fillis believed that pyelolymphatic backflow was due to an anomalous lymphatic arrangement or leak or possibly to the use of too high a pyelographic pressure. In his

Fig. 4. Bilateral ureteropyelograms taken in upright position after injecting 6 c.c. of 20 per cent skiodan into right kidney pelvis and 5 c.c. into left pelvis. Arrows point to injected perirenal lymphatics which originate from lower major calyx and cross pelvis to pass medially toward juxta-aortic lymph nodes.

case, Fillis conceded the possibility of pyelovenous backflow being the underlying cause of the pyelogram obtained. On the other hand, Exley is of the opinion that demonstration of the perirenal lymphatics by pyelography is probably of no significance in the absence of chyluria. He concedes the possibility that in some pathological or physiological states, pyelolymphatic backflow does take place between the kidney pelvis and the lymphatics of the renal parenchyma.

In 1933 Yamanouchi observed 13 cases (65 per cent) of pyelovenous backflow in a series of 20 cases of hematochyluria, and observed the same phenomenon in 28.8 per cent of normal kidneys. He maintained that there was a close relationship between pyelovenous backflow and the pathological changes in the kidney in cases of hematochyluria. He stated that pyelolymphatic backflow was also observed in hemato-

chyluria but that this phenomenon was not a specific picture of hematochyluria. Due to the inability to obtain a translation of his paper, it is impossible to state the exact number of cases of pyelolymphatic backflow reported. However, in examining the pyelograms accompanying the paper, one is inclined to interpret 4 of the cases as probable examples of pyelolymphatic backflow (Fig. 4 in Table I; Figs. 1, 2, and 6 in Table II). In 3 three of these cases, the injected lymphatics appeared to originate in one or more of the major calyces and in the fourth case the lymphatics apparently originated in the pelvis of the kidney.

While it is generally agreed that injection of the perirenal lymphatics by retrograde pyelography represents an open communication between the lymphatic and urinary systems, the exact mechanism responsible for the production of this phenomenon in cases of non-parasitic chyluria has not been determined clinically or experimentally. Several etiological factors or possibilities suggest themselves for consideration, i.e., (1) the pyelolymphatic backflow is associated with a non-demonstrable chyluria; (2) the roentgenographic picture may be an unusual or exaggerated form of pyelovenous backflow; (3) the pyelolymphatic backflow may be the result of increased pressure during pyelography; and (4) the phenomenon may be attributed to an anomalous lymphatic arrangement.

(1) In view of our present lack of knowledge of the anatomy, physiology and pathology of the renal lymphatics, one is rather reluctant to accept without reservations the views of Wesson on this matter, viz. that injection of the perirenal lymphatics by retrograde pyelography occurs only in cases of chyluria and that failure to demonstrate the presence of chyluria is the result of faulty diagnostic technique. It is difficult to comprehend how a non-demonstrable chyluria plays any role in the pyelographic demonstration of perirenal lymphatics in a patient presenting a negative clinical history, an absence of positive findings on physical examination, cystoscopic study and operation, and with repeatedly negative tests for the presence of chyle in the urine on the same and different days under varying circumstances. The fact that chyluria was not present in 8 of the 13 cases of injected perirenal lymphatics would also seem to indicate that pyelographic demonstration of perirenal lymphatics is probably of no clinical significance in the absence of chyluria.

(2) Several observers, particularly de la Pena, have considered pyelolymphatic backflow as a form of pyelovenous backflow, the assumption being that pyelovenous backflow is the underlying cause or mechanism concerned in the injection of the perirenal lymphatics. In order to have a pyelolymphatic backflow superimposed upon or secondary to pyelovenous backflow, it must be assumed that, following the initial rupture into the venous system, there occurs a secondary rupture into the lymphatics of the parenchyma. From an anatomico-pathological standpoint it is extremely difficult to conceive or explain how the same minimal or secretory pressure causing the rupture of the pelvis into the venous systems could continue to exert sufficient pressure to produce a further rupture of the venous elements into the immediate perivenous or parenchymal lymphatic network. The latter phenomenon has never been observed experimentally. Fuchs and others have shown that if the initial pressure producing the pyelovenous backflow is gradually increased following the initial rupture into the venous system, there may develop a rupture of the veins producing a parenchymatous infiltration into the peritubular and interstitial tissue. The appearance of contrast fluid in the parenchyma which may partially or totally obscure the fine strand-like shadows emerging from the tip and fornices of the calyces into the parenchyma. The development of a pyelolymphatic backflow secondary to a pyelotubular backflow has likewise never been demonstrated. For these reasons the author

feels that we may dismiss the possibility of pyelovenous backflow serving as the cause of injection of the renal or perirenal lymphatics. However, it is well to point out at this time the fact that the roentgenographic picture of pyelolymphatic backflow especially in those cases presenting injection of lymphatics in the region of the minor calyces may be easily confused with that of pyelovenous backflow, although ordinarily the pyelographic picture is quite different and distinct in the two forms.

(3) The author agrees with Wesson that over-injection or excessive pressure at the time of injection of the pyelographic medium is not the responsible factor in the production of injected renal or perirenal lymphatics. It is of special interest to note that, in the work of Marcus, and Hinman and Lee-Brown, the injection pressure necessary to produce a pyelovenous backflow in kidneys of living and dead animals was well below the renal secretary pressure. Experimental and clinical studies have shown that when abnormally high pressures are used for injecting the pyelographic medium into a normal kidney pelvis, there may result a severe form of pyelovenous, pyelotubular or pyeloparenchymatous backflow or a combination of two or more of these types of backflow. Kindall, Hunner and the author have emphasized the dangers of syringe pressure pyelography and its role in the production of rupture of the pelvis whose walls have been pathologically weakened as a result of a chronic inflammation or hydronephrosis secondary to an obstruction of the ureter or pelvis. Hunner has pointed out that rupture of a pathologically weakened pelvis may even follow the gravity method of pyelography.

The cautious urologist is cognizant of the fact that in the syringe method of pyelography a wide discrepancy may exist between the actual injection pressure and the operator's estimation of the pressure exerted, and consequently will employ either manometric control of the syringe pressure or the gravity method to avoid any unpleasant sequelae. A preliminary determination of the capacity of the renal pelvis made by injecting sterile water will enable the operator to control the volume of pyelographic fluid to be injected.

The method of pyelography employed in the 13 cases of injected perirenal lymphatics was gravity (low pressure) methods in 3 cases and syringe pressure in 4 cases. In the remaining 6 cases, the method was not stated but presumably was of the syringe pressure method. As far as we have been able to determine excretion urography has never been employed to detect the presence of injected perirenal lymphatics. In Wesson's 3 cases of chyluria the perirenal lymphatics were demonstrated pyelographically by the gravity method which would seem to indicate that this phenomenon was not due to over-injection or excessive pressure but rather to the easy penetration of the contrast fluid into enlarged open lymphatics.

(4) It is apparent from a review of the literature that the anatomy and physiology of the lymphatics are in dire need of further study. While the role of the renal lymphatics and pyelolymphatic backflow in the absorption of dyes from a hydronephrotic pelvis has been definitely established and generally accepted, one must concede the fact that experimental demonstration of the renal and perirenal lymphatics following the intrapelvic injection of a pyelographic medium has not been entirely successful, or, at best, the results have been far from convincing. However, we must likewise concede the possibility that in some physiological and pathological conditions, pyelolymphatic backflow can be demonstrated roentgenographically. Under such conditions, the etiological factor, which would very satisfactorily explain the injection of the renal and perirenal lymphatics, is a congenital or acquired anomalous arrangement of the lymphatics of the kidney, and the mechanism concerned in the demonstration of these lymphatics is the easy penetration of the contrast medium into the abnormal

communications of these lymphatics with the pelvis and calyces.

Anatomical variations in the structure and course of the renal lymphatics are difficult to demonstrate due to the decided paucity of specimens showing pathological changes in the renal lymphatics and to the technical difficulties attending the injection and dissection of the fine calibered lymph vessels in normal and pathological specimens. In the acquired type of anomalous renal lymphatics which is usually accompanied by chyluria, the variations in the course and structure of these lymphatics represent secondary or compensatory changes which develop following an obstruction of the thoracic duct by an inflammatory (parasitic), suppurative or neoplastic disease in the thoracic, mediastinal, peritoneal or retroperitoneal regions. As a result of this obstruction, the renal lymphatics are converted from fine channels to large dilated vessels which communicate with the renal pelvis or calyces at one or more points of rupture. Through these points of rupture the pyelographic fluid may easily penetrate the renal and perirenal lymphatics.

Little is known of the congenital type of anomalous renal lymphatics. It is possible that many cases of the so-called nonparasitic chyluria belong to this group. One must also consider the possibility that, in those cases of injected perirenal lymphatics unaccompanied by a demonstrable chyluria, an acute, chronic, or intermittent obstruction to the thoracic duct may be present as the result of some organic disease or functional disturbance and still remain unsuspected or unrecognized by our present diagnostic procedures.

CASE REPORTS

Case 1. M. F., aged forty-five years, white, male, single, laundryman. Admitted to the Sinai Hospital July 27, 1933.

Complaint: Pain in the right lower quadrant.

Family History: Irrelevant.

Past History: Patient was born in Russia and came to Baltimore at the age of six years. He resided in Baltimore until the age of twenty when he moved to New York City where he has been living for the past twenty-five years. He has not visited or lived in the tropics or Orient. He has always been in excellent health and has suffered no serious illness in childhood or adolescence. He had a gonorrheal urethritis at the age of twenty and made an uneventful recovery.

Present Illness: About one year ago, he developed a sudden, sharp, knife-like pain in the right lower quadrant which radiated up to the umbilicus and to the right costovertebral region but not to the scrotum or thigh. This pain lasted about three hours and was followed by a constant dull ache in the right lower quadrant which persisted for about two weeks. The patient states that he had some elevation of temperature and hot flushes during the first few days of this attack but had no nausea, vomiting or chills. He did not complain of urgency, frequency, nocturia, dysuria, burning on urination or incontinence. There was no hematuria, pyuria or "milky" urine. He does not recall having passed a calculus or gravel. He was confined to bed for two weeks and was treated by his family physician who gave him some "white powders."

He was free from all symptoms until the last week of June, 1933 when he developed another sudden attack of pain in the right lower quadrant. The pain was more severe at first and then became intermittent in nature, recurring at intervals of one or two hours. A dull pain in the right lower quadrant has persisted to date. The radiation of pain was similar to that of the first attack. The patient obtained some relief by applying ice bags to the right lower quadrant. He states he has left "feverish" on several occasions in the past month but has had no nausea, vomiting or chills. He has had no urinary symptoms. There has been no gastrointestinal complaint other than a moderate constipation which requires cathartics or laxatives every second day. He has not lost any weight or strength.

Physical Examination: The only positive findings were confined to the abdomen. The lower pole of the right kidney was palpable but not tender. There was a moderate degree of spasticity of the muscles in the right lower quadrant accompanied by tenderness on deep palpation in this area. There was no tenderness in the right upper quadrant or the right lumbar

region. There were no palpable masses, herniae, or inguinal glandular enlargement.

Laboratory Studies: Hemoglobin, 70 per cent (Sahli); red blood count 4,180,000; leucocyte count 8950, with 83 per cent polynuclear leucocytes; 12 per cent large and small lymphocytes; 3 per cent eosinophiles; and 2 per cent large mononuclears. Blood sugar .086 mgm. per cent. Urine (admission specimen): acid; specific gravity, 1.018; faint trace of albumin; sugar negative; and on microscopic examination was negative for pus cells, red blood cells and bacteria. Blood Wassermann negative. Repeated examinations for filaria and other parasites in the blood, urine and stool were negative.

Course in Hospital: Cystoscopy was performed on July 27, 1933. The bladder walls were negative. There was no enlargement of the vesical orifice. Both ureteral orifices were normal in size, shape and appearance. Clear urine was seen escaping from each orifice. A no. 6 catheter was passed up each ureter to the pelvis with ease. A specimen of urine from each kidney was negative. The right pelvic capacity was 7 c.c. and the left 6 c.c. A plain roentgenogram of the genitourinary tract revealed no shadows in the renal, ureteral and vesical regions. A bilateral pyelogram was taken in the recumbent position after injecting 6 c.c. of 20 per cent skiodan into the right pelvis and 5 c.c. into the left pelvis (Fig. 4). The injections were made with a 20 c.c. Luer syringe using no unusual or undue pressure. The patient did not complain of any pain in either kidney region during or after the injection. Both pelves were normal in size, shape and position. On the right side, two transverse striations were noted extending from the medial aspect to the inferior major calyx, crossing the pelvis to pass medially toward the vertebral column. After an interval of three minutes, the ureteral catheters were slowly withdrawn while an additional 2 c.c. of the dye were injected to fill the ureters and a bilateral ureteropyelogram was taken in the upright position. The right pelvis appeared to have dropped about 2 cm. The ureter was well filled on each side. The same transverse striations noted in the previous pyelogram were seen again and apparently shifted with the kidney. These striations were interpreted as injected perirenal lymphatics.

Inasmuch as no major urological disease was found to account for the patient's symptoms it was felt that a chronic appendicitis was the etiological lesion responsible for the patient's symptoms and operation was deemed advisable.

On July 28, 1933, a right rectus incision was made under ether anesthesia. The appendix was retrocecal in position and contained a fecolith near its base. There was no inflammatory process present in the appendix. The appendix was removed. Exploration of the liver and gall bladder revealed no gross changes. Palpation of the right kidney and ureter through the posterior parietal peritoneum disclosed no unusual findings. The patient made an uneventful recovery.

During his stay in the hospital, his urine was examined repeatedly, i.e. day and night specimens, hourly specimens after being in the recumbent, semi-recumbent and upright positions for at least four to six hours; after walking and exercising; hourly specimens for four hours after meals. The hourly specimens of urine after meals were taken on several succeeding days while the patient was on the normal maintenance (hospital) diet, and again on several occasions after the patient had been given a heavy fat meal consisting of two glasses of equal parts of milk and cream and toast with a large portion of butter. All these specimens were negative for fat and chyle.

The patient made an uneventful recovery and was discharged from the hospital on August 11, 1933. He returned for re-examination on August 25, 1933 when specimens of urine from the previous night, that morning and after meals that day were examined but proved to be negative for fat and chyle. The patient was requested to return for further pyelographic and metabolic studies but failed to do so.

Comment: The demonstration of injected perirenal lymphatics in this case is probably of no significance in the absence of chyluria. Determination of the cause or mechanism of the pyelolymphatic backflow in this case is extremely difficult. The author is inclined to believe that the injected perirenal lymphatics in this case represents a pyelolymphatic backflow which is due to the easy penetration of the pyelographic medium into the anomalous lymphatic arrangement in the kidney.

The author feels that a non-demonstrable chyluria played no role in the production of the injected perirenal lymphatics in this case in view of the negative clinical history, the absence of positive findings on physical examination, cystoscopic study and operation, and the repeatedly negative tests for the presence of chyle in the urine on the same and different days under varying circumstances. While the author is cognizant of the fact that chyluria may be intermittent or functional in nature, there does not appear to be any reason for suspecting the existence of this type of chyluria in this case.

The possibility of pyelovenous backflow being the underlying cause of injection of the perirenal lymphatics in this case can be readily dismissed. There were no evidences of pyelovenous backflow in either of the two pyelograms showing the injected lymphatics. Furthermore, the injected perirenal lymphatics can be easily differentiated from calcification of the renal blood vessels by the fact that the irregular shadows representing the injected lymphatics were not visible in the plain roentgenogram taken before the pyelographic studies were begun. Despite the fact that manometric control of the pressure was not employed during the syringe method of pyelography in this case, the author is also inclined to disregard the possibility that an over-injection or excessive pressure was exerted which was sufficient to produce a backflow into the lymphatics. The author is of the opinion that no undue pressure was exerted during the injection of the pyelographic medium as evidenced by the fact that the volume of contrast fluid was 2 c.c. less than the pelvic capacity (as determined by preliminary injection) and by the fact that the patient did not complain of pain during or after the pyelography. However, it is well to point out that a wide discrepancy may exist between the actual injection pressure and the operator's estimation of the pressure noted.

Case II. I. G., thirty-three years of age, white, male, married, Jewish, tailor. Admitted to the Sinai Hospital, January 13, 1934.

Complaint: Pain in left lumbar region.

Family History: Non-contributory.

Past History: Patient states that he has always enjoyed good health. He gave no history of gonorrhea or syphilis. He was born in Russia and emigrated to the United States in 1914. He served three years with the British Expeditionary Forces (Jewish Legion) in Palestine during the World War. During his war service he was hospitalized for two months because of chills, fever, general malaise and pain in both renal regions. The patient had been previously admitted to the Sinai Hospital on October 22, 1933 because of right renal colic of thirty-six hours' duration. He also had frequency, burning on urination and dysuria. He had gross hematuria on the day before admission. At cystoscopy, blood urine was observed escaping from the right ureteral orifice. Pyelographic studies revealed a normal pelvis, calyces and ureter on the right side. Although no calculus was demonstrated in the upper urinary tract on the right, it felt that the patient had passed a small calculus from his right ureter or kidney. The pain was relieved following the cystoscopy and the patient was discharged from the hospital on October 27, 1933.

Present Illness: The patient had no further attacks of pain or urinary difficulties until 10 P.M. on January 12, 1934 when he developed sudden sharp pain in the left lumbar region which radiated downward and forward to the left testicle. The pain persisted for five hours until his admission to the hospital and was accompanied by nausea, vomiting, chills and fever. He also complained of frequency, hesitancy, burning, dysuria and pollakiuria. There was some intermittency accompanied by the feeling of incomplete emptying of the bladder. The pain in the left lumbar region appeared to be increased during voiding and defecation. Patient did not observe any blood or pus in the urine.

There were no complaints referable to the gastrointestinal system other than a moderate constipation and some fresh bleeding at stool due to hemorrhoids. There were no symptoms referable to the cardiorespiratory or neuromuscular systems.

Physical Examination: Patient was a well-developed, well-nourished and rather obese

individual of short stature. The positive findings are limited to the abdominal examination. There was rather marked tenderness in the left lower quadrant, left lumbar region and left costovertebral angle. There was no spasticity or rigidity of the abdominal musculature. Neither kidney was palpable. No masses or herniae were present.

Laboratory Studies: Hemoglobin, 75 per cent (Sahli); red blood count 4,190,000; leukocyte count 17,000 with 88 per cent polynuclears; 10 per cent small and large lymphocytes; and 2 per cent large mononuclears. Voided specimen of urine was cloudy due to the presence of phosphate crystals; acid reaction; specific gravity 1.024, negative for albumin and sugar; and microscopically showed an occasional red and white blood cell but no bacteria. An intravenous phthalein test showed 500 c.c. with 50 per cent for the first hour and 300 c.c. with 20 per cent for the second hour. Blood Wassermann negative.

Course in Hospital: The patient was kept under observation until January 16, 1934 when cystoscopy and pyelography were performed. The bladder walls were normal. The left ureteral orifice appeared to be slightly enlarged and congested giving the impression that a stone had been passed recently. Clear urine was seen escaping from each ureter. A no. 7 catheter was passed up the left ureter to the pelvis with ease. A no. 6 catheter passed up the right ureter with ease. Specimens of urine obtained from each kidney by ureteral catheterization were negative except for an occasional red blood cell due to trauma incidental to catheterization. The left renal capacity was 12 c.c., the right 10 c.c. A roentgenogram of the genitourinary tract with a catheter in each ureter was negative for shadows in the renal and ureteral regions. Bilateral stereoscopic ureteropyelograms were taken in the horizontal position after injecting 10 c.c. of 20 per cent skiodan into the left kidney pelvis and 8 c.c. into the right pelvis. The injections were made slowly and no undue pressure was exerted although the patient did complain of some pain in the left renal region during the pyelographic injection which disappeared after a few minutes. The right renal pelvis and calyces were well filled and appeared to be normal in size, shape and position. The right

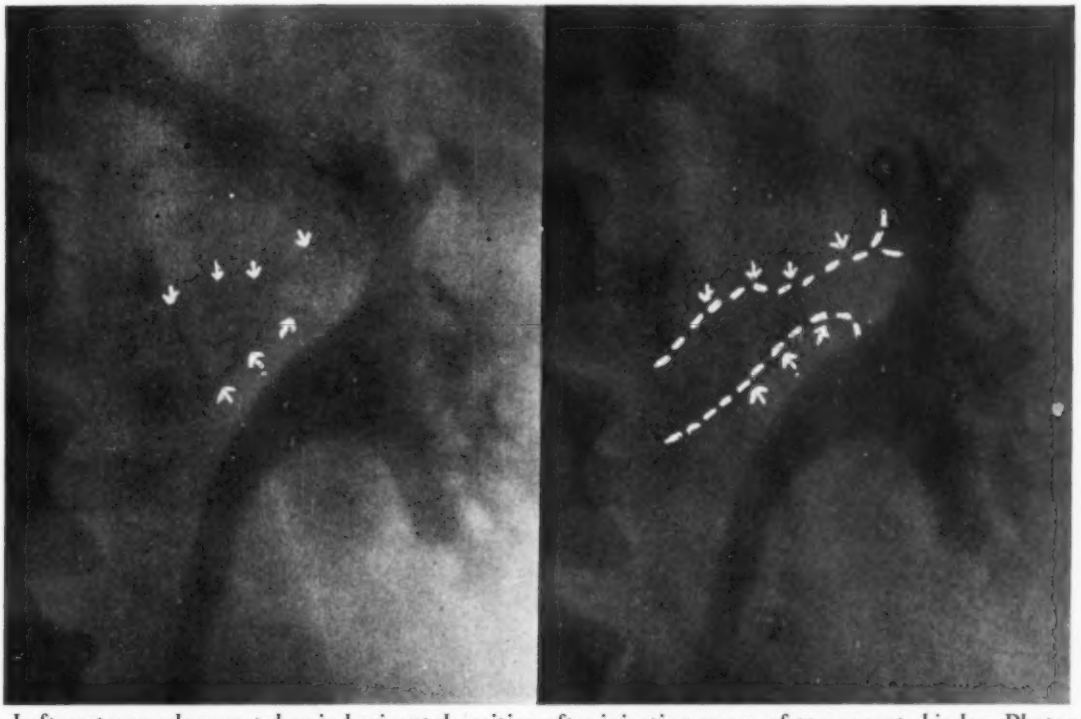

Fig. 5. Left ureteropyelogram taken in horizontal position after injecting 10 c.c. of 20 per cent skiodan. Photograph on left is untouched and injected perirenal lymphatics are indicated by arrows. Pyelogram on right is same but perirenal lymphatics originating from superior calyx and pelvis are indicated by dotted lines. Evidences of pyelovenous backflow about middle major and minor calyces can be clearly seen.

ureter appeared to be dilated in the upper third.

On the left side, the pelvis and calyces were well filled and normal in size, shape and position. At the tips of the minor calyces and in the space between the minor calyces are found numerous irregular shadows which in some areas are arched and in others are blotchy. These shadows are interpreted as roentgenographic evidences of pyelovenous backflow. There are several irregular tortuous shadows extending from the medial aspect of the superior major calyx and the superior aspect of the pelvis which pass outward beyond the outline of the kidney past the lateral border of the left psoas muscle to extend medially in the direction of the vertebral column. The latter shadows are interpreted as injected perirenal lymphatic indicating a pyelolymphatic backflow. (Fig. 5.)

In view of the latter findings, special studies were undertaken to detect the presence of chyle in the urine. Specimens of urine were taken after the patient had been in recumbent and upright positions for at least four hours and for several hours after a fatty meal but no chyle or fat was found. Studies for the presence of filaria in the urine and blood were negative. The patient was carefully questioned about passing whitish or milky urine but failed to give a positive history of it.

Pyelographic studies were repeated on February 9, 1934 and disclosed a normal pelvis on the left side. There were no evidences of pyelolymphatic or pyelovenous backflow. Further tests for the presence of chyle in the urine have been made under varying circumstances but were negative.

Comment: Although this case presented the unusual combination of pyelovenous and pyelolymphatic backflow, the author does not feel that there is any casual relationship between the two phenomena but is inclined to consider their occurrence as a mere coincidence. The etiological role of over-distention or increased injection pressure can not be excluded entirely inasmuch as manometric control of the syringe pressure was not employed. In view of the fact that the amount of pyelographic medium injected was 2 c.c. less than the estimated pelvic capacity and the injection was made slowly without undue pressure would tend to minimize the influence of excessive injection pressure in the production of injected perirenal lymphatics. In the absence of a demonstrable chyluria, the author is of the opinion that the injected perirenal lymphatics in this case are the result of the easy penetration of the contrast fluid into an anomalous renal lymphatic arrangement.

The author feels that the tortuous shadows extending from the kidney past the border of the psoas muscle are injected perirenal lymphatics. The question as to whether these shadows are due to pyelovenous backflow can be readily eliminated inasmuch as in none of the clinical or experimental observations of this phenomenon has the presence of such shadows extending beyond the confines of the kidney been demonstrated.

CONCLUSIONS

A careful study of the 2 cases of injected perirenal lymphatics unassociated with a demonstrable chyluria herein reported and a review of 11 cases of injected perirenal lymphatics in the literature justifies the following conclusions:

1. The phenomenon of pyelolymphatic backflow can be graphically demonstrated by injection of the renal and perirenal lymphatics during pyelography. While this phenomenon has been observed in 13 clinical cases, attempts to produce the same in the experimental animal have not been entirely successful or convincing.

2. Injection of the renal and perirenal lymphatics during pyelography not only occurs in patients with parasitic or non-parasitic chyluria but also in patients with an absence of chyluria or a non-demonstrable chyluria.

3. The exact mechanism concerned in the pyelographic demonstration of the communication between the pelvis and the renal and perirenal lymphatics is a mooted question. The author is of the opinion that injection of these lymphatics is the result of the easy penetration of the pyelographic

medium into anomalous renal lymphatics which may be congenital or acquired in nature.

4. The acquired type of anomalous renal lymphatics, which is usually associated with a chyluria, is exemplified by the dilatation and tortuosity of the renal lymph vessels following an obstruction of the thoracic duct resulting from an inflammatory, suppurative or neoplastic disease in the thoracic, mediastinal, peritoneal or retroperitoneal region. The chyluria is the result of the rupture of one or more of these dilated, tortuous lymph vessels thus establishing a communication between the renal lymphatics and the pelvis. It is through the same points of rupture that the contrast fluid penetrates and injects the renal and perirenal lymphatics.

5. The congenital type of anomalous renal lymphatics in all probability is present in the cases of injected perirenal lymphatics unassociated with a demonstrable chyluria and in some of the cases of non-parasitic chyluria. The presence of this type of anomalous renal lymphatics has not been demonstrated which may be due to (a) our scant knowledge of the normal anatomy and physiology of the renal lymphatics; (b) the dirth of pathological specimens showing such changes; and (c) the technical difficulties encountered in injecting normal and pathological renal lymphatics. In this type, anatomical variations in the course and structure of renal lymphatics may be present and produce a direct communication between the renal lymphatics and the pelvis which will permit the easy penetration of the pyelographic fluid.

6. Overdistention of the renal pelvis and excessive pressure at the time of pyelography play no role in the production of injected renal or perirenal lymphatics.

7. These studies strongly emphasize the dire need of further investigations of the anatomy and physiology of the renal lymphatics and the necessity for careful pyelographic studies in cases of parasitic or non-parasitic chyluria of renal origin in order to demonstrate the exact point of communication between the lymphatic and urinary systems and to enhance our knowledge of the renal lymphatics.

Fig. 6. Right pyelogram taken in horizontal position. Injected perirenal lymphatics originating from superior calyx are indicated by arrows. Evidences of pyelovenous backflow about terminal portions of middle and lower major calyces can be seen.

A third case of pyelolymphatic backflow has been encountered by the author since this paper was submitted for publication. The patient was a white married male of twenty-seven years, employed as an orderly. He was born and has always lived in the southeastern part of the United States. He was admitted to the hospital on July 9, 1934 for right renal colic. Physical examination was negative except for slight tenderness in the right lumbar region and right lower quadrant. A voided specimen of urine on admission showed an occasional pus cell and red blood cell.

Cystoscopy and pyelography were performed on July 10, 1934. The right ureteral orifice appeared to be dilated and congested which was apparently due to the passage of a small stone from the right ureter. There were no obstructions in the right ureter when the catheter was passed. Urine obtained from the

right kidney was clear and contained an occasional pus cell. Capacity of the right renal pelvis was 12 c.c.

The right pyelogram was taken after injecting 10 c.c. of 20 per cent skiodan by the syringe method. The injection was made slowly and without undue pressure. The right kidney pelvis appeared normal in size, shape and position. There were some evidences of pyelovenous backflow about the lower major calyces. There was a thin, irregular transverse striation extending from the infundibular portion of the upper major calyx in a slightly downward direction toward the vertebral column (Fig. 6). About 3 cm. from its infundibular origin, the striation divides into two distinct branches. These transverse markings were interpreted as injected perirenal lymphatics.

During his stay in the hospital, separate specimens of urine were obtained in the morning and at night, following changes in posture, and after a heavy fat meal but the presence of chyle in the urine was not demonstrated.

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NEPHROSTOMY IN PYELONEPHRITIS*

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THOUGH nephrostomy has been advocated for many renal lesions, references to its use in pyelonephritis are infrequent and usually brief. Crosbie[1] states: "Double nephrostomy gives more relief than anything else I have found for the cases of double chronic pyelonephritis with megaloureters." Chute[2] in discussing non-tuberculous renal suppurations states that drainage through the loin is indicated in the more advanced cases. Mathe[3] in discussing modern treatment of pyelonephritis dismisses the subject with the statement that in particularly resistant and recurrent types of pyelonephritis, it is sometimes necessary to resort to surgical drainage employing the method of Marion. Among other indications for nephrostomy Cabot and Holland[4] cite "a group of cases of renal infection without high grade obstruction in which the nephrostomy is done as a method of avoiding recurrent renal infection and allowing some amount of renal recovery."

In considering the treatment of pyelonephritis one must keep in mind the fact that the mechanics of the passage of urine from the renal cortex to the bladder includes more than the flow of a fluid from a higher to a lower level. Muscular and neurogenic elements are predominating factors with the diameter and relations of the various hollow structures playing an important part.

Adequate drainage is a fundamental surgical principle of treatment of disease when pus or infected fluid of any kind is present. Tissue reaction to infection results in swelling and edema. Swelling and edema in the calyces, pelves and ureters occur to a marked degree in very acute pyelonephritis. In the cases which we shall report the kidneys were not only seen to be highly inflamed and congested but the pelves thickened and edematous, the ureters several times normal size with thick, edematous walls. Much peripelvic and periureteral inflammation was present in all cases. This inflammatory reaction interferes with renal drainage by actual diminution in the caliber of the ureter from swelling in the wall and by interfering with peristalsis. True inflammatory strictures do not occur until late in the disease. Ureteral bulbs if passed by the orifices, which are usually spastic, pass freely up these ureters without evidence of obstruction, and yet in one of our cases an opaque medium introduced into the kidney pelvis was found to be there one hour and fifteen minutes later. This interference with drainage brings about an increased intrarenal pressure which forces the infection into the cortex of the kidney.

A small intrarenal pelvis will aggravate this condition of back pressure on the calyces more than an extrarenal pelvis as pointed out by Rose, et al.[5] Rose has also called attention to the fact that all components of the kidney do not drain with equal ease.

The advantage of nephrostomy over the use of indwelling catheters arises from the constant and satisfactory drainage which can be obtained. To accomplish this in all cases for any considerable period of time with catheters is impossible. Even when the catheter tip is placed at the most advantageous point a portion of the pelvis and lower major calyx lies below its level in many kidneys. As a result the entire content of the pelvis is not drained.

* Presented before the North Central Branch of the American Urological Association, Chicago, Ill.

FIG. 1. Case 1. Bilateral pyeloureterogram, April 10, 1928, showing little change in pelves and calyces but moderate dilatation in mid-portion of both ureters.

FIG. 2. Case 1. Left pyeloureterogram, May 6, 1928, showing dilatation in pelvis and calyces.

FIG. 3. Case 1. Right pyeloureterogram, August 13, 1928.

FIG. 4. Case 1. Bilateral pyeloureterogram, October 11, 1928. Right side incompletely filled. Dilatation in left pelvis, calyces and ureter increased.

FIG. 5. Case 1. Right pyeloureterogram, October 16, 1928.

FIG. 6. Case 1. Right pyeloureterogram, January 10, 1930.

FIG. 7. Case 1. Left pyeloureterogram, February 10, 1930.

FIG. 8. Case 1. Left pyeloureterogram taken seventy-five minutes after injection with opaque medium. During interval patient was permitted to be up and about and void.

Furthermore, it is difficult and oftentimes impossible to keep the catheter at the proper level to maintain the most satisfactory drainage.

Fig. 9. Case 1. Left pyeloureterogram, June 11, 1930.

Fig. 10. Case 1. Intravenous urogram with nephrostomy tubes clamped, August 20, 1931. Picture taken thirty minutes after injection of dye. Note absence of dye in ureters and bladder.

The fine line dividing conservative and radical measures in the treatment of urological lesions is nowhere better exemplified than in the care of patients with pyelonephritis.

In order to pointedly state our position with regard to the value of nephrostomy in acute pyelonephritis we must cite those cases in which we do not think it indicated. When the response to any form of internal medication, dietary treatment or indwelling catheters is satisfactory, operation is obviously unnecessary. When cortical abscesses have developed we do not expect any great benefit from nephrostomy. The clinical entities on which we base this discussion are the acute fulminating infections which do not improve under conservative management, and the low-grade chronic processes existing for a long period of time with progressive renal damage.

A nephrostomy tube judiciously used at the right time, thus converting a closed system depending upon muscular and neurogenic factors for drainage into an open system depending entirely upon a large opening properly placed for purely mechanical drainage, will in most cases arrest the infection without further danger to the kidney and the patient's life.

The muscular and neurogenic elements are put at rest, as no other method will do, and the factor of back pressure on the renal cortex is satisfactorily interrupted. Recovery from the infection can then proceed by the usual process and if recovery is not complete further pressure destruction and to a large degree inflammatory destruction of renal function is arrested.

Four case reports will be given briefly:

Case 1. A man, first seen on March 17, 1928, at the age of twenty-four and whose course was followed closely until his death more than four years later on May 1, 1932. This case was reported to this Society in 1928, as one of a series of cases of gonococcal pyelonephritis. When first seen he had a gonorrhea of five months' duration and complained of frequency, dysuria and terminal hematuria. The urine from both kidneys showed numerous

FIG. 11. Case 1. Retrograde ureterogram, October 1, 1931. Medium could not be forced beyond level of fourth lumbar vertebra. No evidence of ureteral orifice was seen on left side.

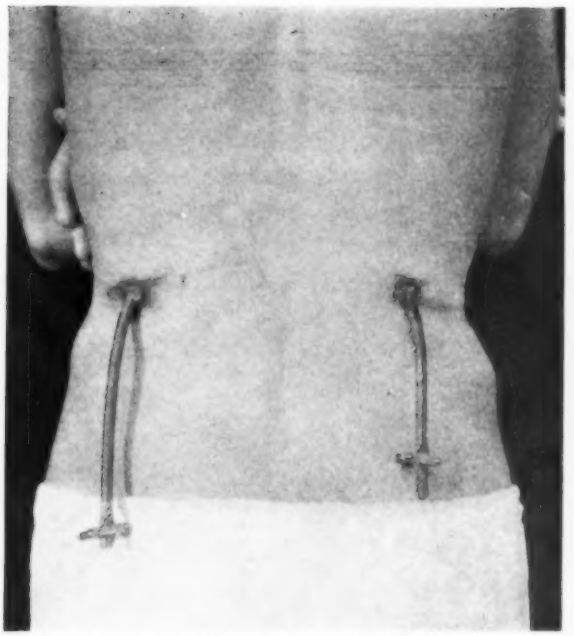

FIG. 12. Case 1. Photograph showing nephrostomy tubes.

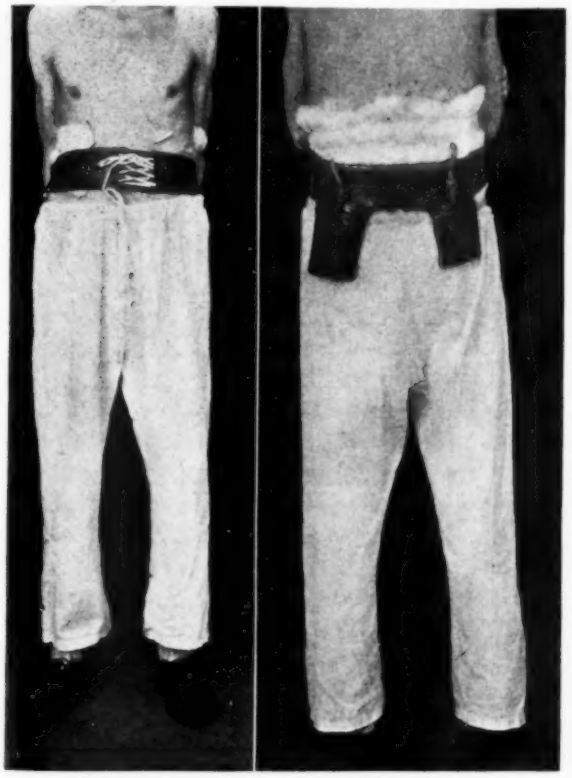

FIG. 13. FIG. 14.

FIG. 13. Case 1. Photograph of patient showing belt to support bottles for collection of urine.

FIG. 14. Case 1. Photograph showing receptacles for urine.

FIG. 15. Case 1. Photograph of kidneys, ureters and bladder after removal at autopsy.

organisms identified as gonococci. In about four weeks' time these organisms had disappeared but many staphylococci were present.

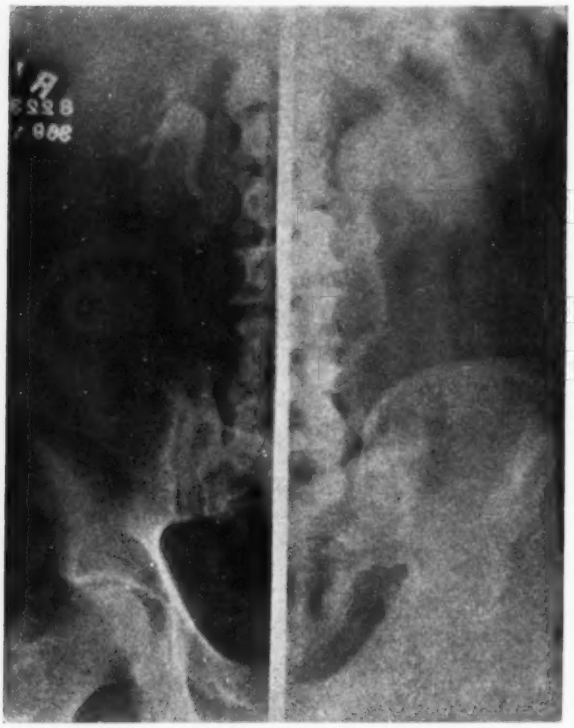

Fig. 16. Case 11. Right and left pyeloureterograms, August, 1932. Right kidney and ureter practically normal. Left pelvis, calyces and ureter somewhat dilated.

These in turn gave way to colon bacilli and streptococci.

As this patient spent between two and three years in the hospital it is unnecessary and obviously impossible to report his record in detail. It will suffice to say that all forms of treatment in general use at that time were tried. These included intravenous injections of various dyes and neo-arsephamine. Seventy cystoscopic examinations were performed. In many instances the ureters were dilated and indwelling catheters inserted. In spite of all forms of treatment progressive destruction of the kidneys with dilatation of the pelves, calyces and ureters and gradual diminution in function occurred. These changes are very well shown in the pyelograms. (Figs. 1–15.)

In January, 1929 double temporary nephrostomies were performed. Following this rapid improvement occurred and more than 25 lb. in weight were gained in two months. Unfortunately, these tubes were removed by the patient when asleep and could not be replaced. In December, 1930 a permanent right nephrostomy was performed and in February, 1931 the operation was performed on the left kidney.

Fig. 17. Case 11. Intravenous urogram, May 3, 1933. Note increase in size of right renal pelvis.

Following these operations great general improvement again occurred. Furthermore, the urine from both kidneys, which at the time of operation and previously had been very purulent, improved rapidly and four months later only an occasional pus cell was found in the urine from each kidney. The excretion of phthalein which had been as low as 15 per cent in two hours from both kidneys returned to an output of 40 per cent; 20 per cent from each kidney in two hours. The general condition improved and the patient returned home and went to work. He was seen from time to time and his general health remained good for about a year after introduction of the nephrostomy tubes. In March, 1932 the patient returned with evidence of nephritis. There was a general arasarca. The non-protein nitrogen was 60 and creatinine 2.1. Phthalein excretion was 30 per cent in two hours. Under treatment the patient again improved and was discharged from the hospital to return in April, 1932, with symptoms which led to a diagnosis of intestinal obstruc-

tion, for which he was operated on and from which he expired on May 1, 1932.

At autopsy both kidneys appeared normal in size, the pelves were dilated, the capsules thickened, the surface of the kidneys mottled and studded with small abscesses and many scars. The lumen in the lower portion of the left ureter was completely obliterated.

Case II. A man, aged fifty-six, with a history of urinary tract infection of seven years' duration. His complaints were extreme frequency, urgency and intermittent hematuria. At intervals he had attacks of chills and fever of many days' duration. The bladder capacity was 60 c.c. The left kidney pelvis, calyces and ureter were dilated; the right kidney pelvis was normal but there was some dilatation in the right lower ureter. Life was intolerable because of the extreme frequency and urgency and the attacks of chills and fever. The kidneys were infected with colon bacilli and staphylococci. Conservative treatment including bladder lavage and hydrostatic dilatation of the bladder over a period of more than three months gave no relief. Nephrostomy was performed on the left side on November 29, 1932. The temperature dropped to normal and the patient was discharged from the hospital.

About six months later, May 1, 1933, he returned to the hospital. During the interval his general condition has improved and he had worn the nephrostomy tube confortably. He still had a very marked urgency and frequency of every half hour during the day and night. The differential phenolsulphonephthalein test gave a return of 20 per cent from the right kidney and 30 per cent from the nephrostomy

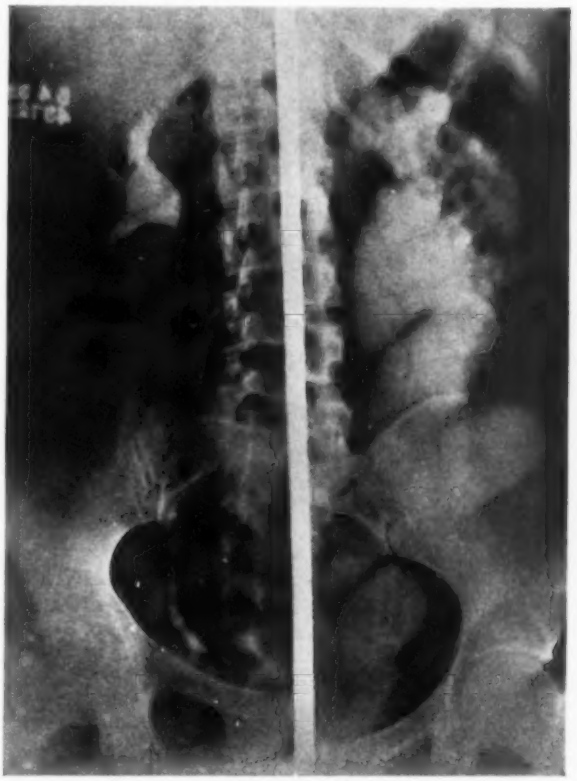

Fig. 18. Case III. Right and left pyeloureterograms, May, 1933. Right is practically normal. Left shows great dilatation in pelvis, calyces and ureter.

tube in two hours. The capacity of the bladder was now about 40 c.c. A pyelogram showed a

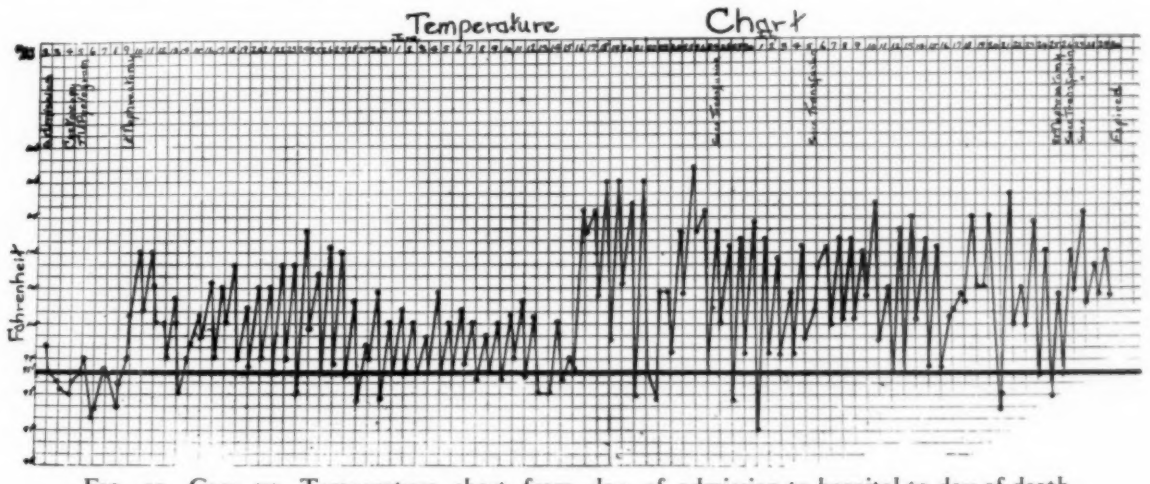

Fig. 19. Case III. Temperature chart from day of admission to hospital to day of death.

The urine collected through the left nephrostomy tube showed only seven pus cells to the microscopic field in the centrifuged specimen. rather marked dilatation in the pelvis of the right kidney, whereas it had previously been normal. In view of the extreme frequency and

evidence of developing hydronephrosis on the right, right nephrostomy was performed on May 16, 1933. At the time of operation the upper ureter was found to be three times normal size, acutely inflamed and very tortuous. The pelvis was dilated and contained about 2 oz. of very turbid urine. The patient was greatly relieved by the operation and was discharged from the hospital on June 21, 1933.

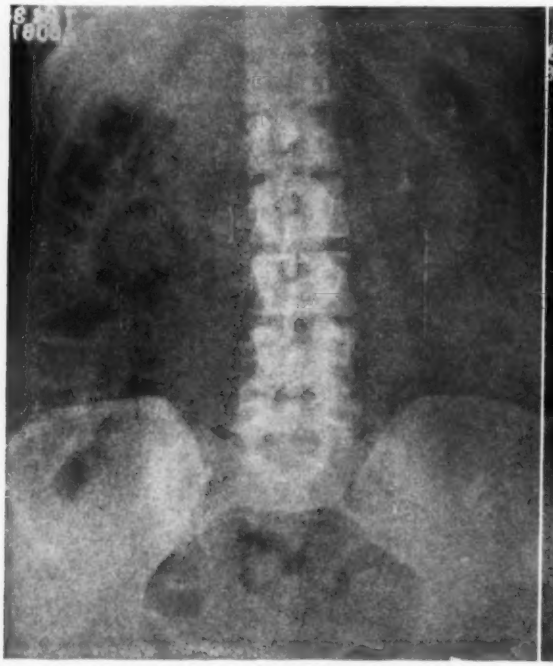

FIG. 20. Case IV. X-ray of calculus in left kidney.

FIG. 21. Case IV. Bilateral pyeloureterograms showing normal kidney and ureter on right side. Left shows deformity resulting from calculus in pelvis.

FIG. 22. Case IV. Bilateral pyeloureterograms, September 9, 1933, three days before nephrostomy was performed on right kidney.

He has subsequently been seen in the outpatient department as recently as September 9, 1933 and reports great general improvement, a gain of 10 lb. in weight, a reduction in the frequency to three times per day and one time at night and the ability to do light work.

CASE III. A woman, aged forty, had a left nephrectomy for hydronephrosis and hydroureter on May 9, 1933 (Fig. 18). Following operation she ran a septic course, had some drainage from the wound, became anemic, and was given several blood transfusions. Cystoscopic studies revealed infection in the remaining kidney which had been uninfected before operation. Cultures showed colon bacilli and streptococci. Continuous ureteral catheter drainage and other conservative measures were tried without benefit. A right nephrostomy was performed on July 22, 1933. Upon opening the kidney pelvis a great deal of pus was evacuated. Following operation the white blood count dropped from 30,000 to 14,000 and general improvement was noted. However, pneumonia developed in the left lung and she expired on July 30, 1933. (Fig. 19.)

CASE IV. A woman, aged forty-five, had a left pelvionephrolithotomy on August 1, 1933.

Following operation a gradually increasing sepsis developed. There was satisfactory drainage through the flank from the kidney which had been operated on. Cystoscopic studies revealed infection (colon bacillus) in the right kidney which had been uninfected before operation (Figs. 20 to 23). Conservative measures including indwelling catheters did not benefit. A right nephrostomy was performed on September 12, 1933. Improvement following operation was rapid. The nephrostomy tube was removed on the seventeenth postoperative day and the wound was healed on the twenty-first postoperative day without an elevation of temperature above 99.8° F.

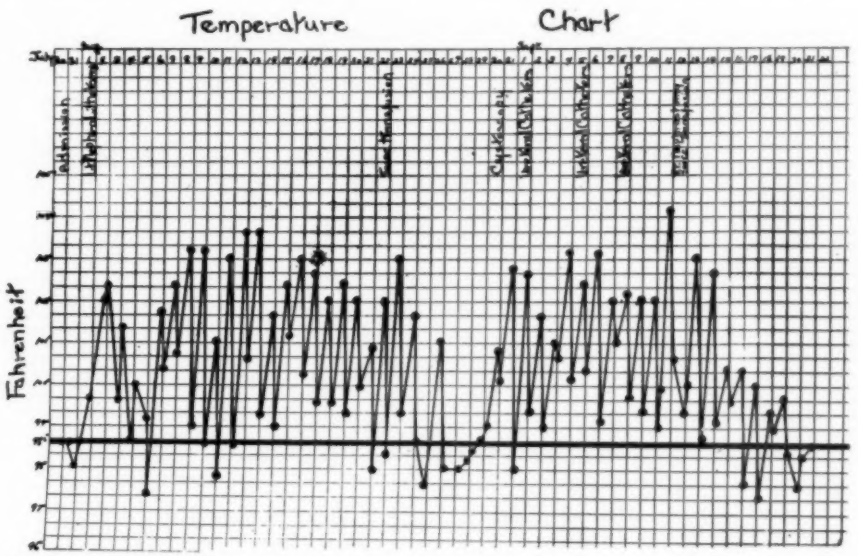

Fig. 23. Case iv. Temperature chart showing rapid drop in temperature to normal following nephrostomy on right kidney.

CONCLUSIONS

1. Acute pyelonephritis may cause great destruction of kidney cortex with reduction in function.

2. The inflammatory process in the wall of the pelvis and ureter and in the peripelvic and periureteral tissues may interfere with drainage early in the course of the disease by diminution in the caliber of the lumen, and by lessening peristalsis.

3. Marked dilatation in the pelvis and ureter may occur without demonstrable evidence of stricture formation.

4. Great stasis of urine may occur as shown by an emptying time of seventy-five minutes in one case reported. This increases the intrarenal pressure and increases the tendency of the infection to invade the cortex.

5. Nephrostomy offers a means of giving constant and complete drainage and should be carried out before great renal damage has occurred.

6. Drainage may be temporary or permanent, depending upon the progress of the case.

7. In many cases nephrostomy will conserve renal function and in some cases it will save human life.

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ORAL DYE THERAPY IN UROGENITAL INFECTIONS*

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NEW ORLEANS

THE urologist is continuously confronted with problems involving urogenital invasion by bacteria. Many instances occur in patients with non-surgical lesions, in children and in those of advanced years; occasionally individuals where no pathological or congenital abnormality can be demonstrated yet where some infectious process renders them unable to carry on normally.

There is no bactericide which, when taken by mouth, kills outright bacteria in the urinary tract. The physical and chemical problems necessary to effect this are so complex that it would seem advisable to work at present with those agents which appear definitely to inhibit bacterial growth. It is with this phase of the problem that we propose to deal.

Of those cases where the infection is limited to the bladder, local therapy alone will generally suffice, but even here better judgment may dictate the consideration of oral drug administration in preference to the traumatism that often accompanies catheter instillations. Most frequently and logically, we employ a combination of drugs by mouth with local treatment.

It is to be deplored that only too many clinicians treat pyurias and bacteriurias, irrespective of cause, with internal medication alone and for this reason many urologists fail to show any interest whatever in furthering investigations in this field.

We should recognize the fact, however, that a large gap in our otherwise effective therapeutic armamentarium lies in this field of internal urinary antisepsis. Until this hiatus is filled, certain enthusiasts must continue their research and, ignoring all active commercial propaganda, attempt to determine whether or not certain of the newer chemo-therapeutic agents possess merits superior to the remedies heretofore employed.

This report is limited to certain dyes of the azo group with especial reference to pyridium, the first of these newer preparations to receive our attention. Observations with methylene blue and neutral acriflavine are briefly reviewed, for comparative value. Our clinical studies with mercurochrome and gentian violet, given orally, have already been published. Briefly we had such consistently severe gastrointestinal disturbances following their use that we had to abandon them. Other drugs in the azo group may or may not produce severe by-effects and may be equally effective on bacteria. Our study has been confined to pyridium in order that an evaluation of its clinical status might be determined. These investigations were begun in 1927.

Practically all past experimental work has been done in the laboratory with normal urines in an attempt to show that normal individuals taking these drugs in therapeutic doses fail to void a urine which, when subjected to living bacterial cultures, demonstrated any antiseptic properties. To us this approach to the subject appears erroneous and misleading.

No less an authority than Ralph Stockman informs us that:

> The treatment of infections of the genito-urinary tract by means of medicines administered by mouth presents many inherent difficulties, and only very little help in overcoming these can be obtained from the kind of information yielded by experiments carried out with

* Read by invitation before a joint meeting of the Section of Genito-Urinary Surgery, New York Academy of Medicine, and the New York Society of the American Urological Association.

test-tubes and bacterial cultures. The conditions in the two cases are so widely different that the real value of any remedy can only be gauged from clinical experience of it.

Claude F. Hoffman says:

> It is evident that exact figures as to the efficiency of different antiseptic drugs in various dilutions are chiefly of academic interest since conditions in the test-tube and in the constantly changing environment of the urinary tract will not bear detailed comparison.

Further quotations in the same vein could be given from writings of students seriously interested in this problem, but we believe these two sufficiently representative.

The selection of the dye should be influenced according to the particular group of organisms for which the compound is intended. Biological chemists, in discussing dye selectivity on bacteria, are moving away from the explanation of phenomena on a purely chemical basis and are tending more to regard them as physical in nature. It has been determined that some antiseptics attack bacteria by coagulating the proteins of their protoplasm but the process is probably not so simple and certainly may not apply to the dyes. By penetration of a dye we usually think that the color or chromophore portion penetrates since this is the only portion of the drug we see. It is perfectly possible that an effective portion of the dye that ultimately reaches the bacteria is colorless and that this changes the cultural processes and interferes with the proliferation or actually destroys certain organisms.

So we believe that the greater part of pyridium ingested is eliminated in a definitely changed form, individual dye metabolism or the reaction of the urine determining the extent or degree in which the change occurs.

Of the diphenylamin groups of dyes, methylene blue is perhaps the best known to urologists. The first clinical report of its use in cystitis and pyelonephritis was published by Max Einhorn in 1891. The voluminous literature upon this dye cannot be reviewed here, but its popularity in the last decade of the 19th century is remembered by most of us. Its wide application in gonococcal infections remained in vogue until quite recently and even today not a few genitourinary specialists consider it of distinct merit as an adjunct in urethral therapy. About 50 per cent of methylene blue ingested is excreted in the urine. The best evaluation of it in urinary antisepsis is to be found in the studies of Frank Hinman who observed that the drug often undergoes decomposition in its passage from the blood, appearing in the urine in the form of leuko-derivatives which are, for the most part, non-bacteriostatic. This phenomenon (decomposition of the dye with accompanying loss of color) was noted by him in all solutions in which bacteria grew. Escherichia coli will decolorize a 1:1000 dilution but staphylococci will not cause loss of color until a dilution of 1:100,000 or greater is reached. In his opinion the absence of deep blue urine indicates imperfect antisepsis, the lack of pigment being due principally to dye decomposition or to renal impairment. It appears of some value in staphyloccoccus infections of the bladder and kidney according to Hinman but is worthless in urethritis. Ten grains of methylene blue, four times daily, have been given without producing toxic effects; 3 to 6 grains a day are doses more commonly used. We wish to plead for a more liberal attitude towards methylene blue. It is not yet ready for the discard.

In discussing the disappointments in attaining a drug sufficiently potent for use in "internal disinfection," Carl H. Browning in 1919 attributes failure to (a) antiseptics in general enter into combination with proteins of the tissues and body fluids, either by a process of physical absorption or by the formation of chemical compounds; (b) most chemical antiseptics are protoplasm poisons damaging tissues as much if not more than microorganisms, and, (c) because of deficient penetrating

power they fail to reach organisms situated in tissues. Browning, at this time, reported his experiments on rabbits with acriflavine that fully 33 per cent of the dye ingested was excreted by the kidneys. It remained for Edwin Davis to establish its value in clinical therapy in 1921. Much credit is due this observer for his painstaking studies as well as for his persistence in making us acriflavine conscious. This dye has merit, as an adjunct, in certain cases. Davis has stated that he found acriflavine distinctly valuable in acute urinary infections, in doses of 0.05 to 0.1 gm., but admits of frequent gastrointestinal disturbances following its administration. He found this dye efficient against Escherichia coli in alkaline urines and against staphylococci in urines of any reaction.

The newer azo group of dyes have not, until recently, received full consideration as urinary antiseptics. In 1926 pyridium was introduced. Serenium, another similar compound, was investigated clinically in 1930 and impressed workers with its low toxicity and high bacteriostatic power. No clinical reports dealing with mallophene have been found but studies of the relation of the hydrogen-ion reaction of the urine to the antiseptic action of this dye in vitro are published. Niazo and ambazine have received attention in urological practice and for gynecological postoperative antisepsis. One hundred sixty-two urologists, in reply to a questionnaire we sent out, stated that they were observing excellent clinical results with one or another of these dyes.

Animal experiments carried out by Robert P. Walton and Edwin H. Lawson at Tulane University have demonstrated for pyridium a low degree of acute toxicity either by oral or intravenous administration. With respect to chronic toxicities, it has been shown that, with large over-doses, the most important points of damage are to the liver and the reticulo-endothelial system with relatively slight or no kidney damage. The relation of the toxic dosage to that used therapeutically has not yet been ascertained and this is a most vital point to be developed, both with pyridium and other urinary antiseptics.

Pyridium occurs as a fine powder, of a dark brick red tint, and dissolves readily in boiling water. Acid in reaction, this dye is quite pronounced in its coloring of the urine, and, to some, this is considered a disadvantage. Though selective in its antibacterial properties, its prompt bacteriostatic effect on certain strains of cocci demonstrate it as being one of the most potent agents we have at present in combating this type of infection by oral therapy. Favorable results in certain cases of coli infection have also been observed. Approximately 60 per cent of pyridium taken by mouth is excreted in the urine. Being tolerated by those free of advanced gastric or hepatic pathology, it is obvious that its clinical value as an internal urinary antiseptic should be carefully investigated. Doses of 0.2 gm., three times a day, are advocated. The length of time this plan of therapy should be followed is governed by the chronicity of the infection as well as the tolerance of the individual patient for dyes generally. Usually seven days of continuous medication is followed by a rest period. No fixed plan can be followed in every instance; the type of organism to be combated and the results noted by cultures and stained smears obtained at intervals, obviously determine the extent of medication.

Whenever clinical observations such as these are recorded it still seems necessary to impress upon some that drugs administered by mouth are adjuncts in the treatment to be followed and not necessarily specifics. The routine procedures acceptable to all urologists are to be employed with the usual care and thoroughness. Patients suffering from congenital or anatomic defects or with advanced pathological entities may not show the same degree of advanced pathological entities may not show the same degree of improvement as those with less pathology. Each case presents an individual problem. In infants

or small children and in the aged oral therapy alone may be employed for a reasonable time, provided results are obtained. Certainly in the presence of surgical lesions, to follow such therapy indefinitely is inexcusable. In any event, uniform clinical results cannot be expected, no matter what drug or procedure is selected. Certain accessory factors, outside the urogenital tract, as for example intestinal stasis, infection in teeth, tonsils, sinuses, in fact any extraurinary focus, must be diligently sought for and eradicated where possible. Since more attention has been given to the foci in the prostate gland and in the cervix, results have been more satisfactory.

The hostile attitude many assume toward dye antiseptics, due to the fact that no specific drug has yet been discovered that will combat all urinary infections, seems to us most irrational. We have found them valuable adjuncts in the treatment of many cases. Sometimes they fail utterly. However, as before mentioned, no conscientious physician places empiric formulae above thoroughly established modes of diagnosis and treatment. For surgery, cystoscopic manipulations, local treatment to the affected part by means of instrumental and chemical aids, vaccines, filtrates and bacteriophages, intravenous therapy, recognizing and removing foci of infection distant from the urinary tract, all aid materially in bringing about the desired results. Drainage of the infected area in the urinary tract is imperative if any relief is to be anticipated. Furthermore the drug must be given in sufficiently large dosage to be effective, a point commonly overlooked. Then too, a concentrated urine renders the drug more effective. As a majority of such patients are past the fifth decade of life, and therefore may have hepatic or digestive disturbances, dye medication should not be prolonged indefinitely. Symptoms of gastrointestinal upset evidenced by loss of appetite, nausea, vomiting, and other similar by-effects may ensue. Periods of medication should always alternate with periods of rest. During these "rest" periods we force the fluid intake. We repeat that we give our patients pyridium in doses of 0.2 gm. (or 3 grains) three times a day (8.5 mg. total daily per kilo of body weight) for seven days. Should no improvement be observed in this length of time, further dye administration is probably useless.

As an adjunct in the preparation of cases for renal, ureteral, bladder or prostatic surgery, we have been able to demonstrate the efficacy of azo dyes in reducing infection to a minimum. This was proved repeatedly by comparison control cases. In these cases much can be accomplished by giving pyridium before, as well as after, surgical procedures.

In prostatism and in tabetic bladders it has a definite field. The dye has been found by us to be a mild deodorant; in cases of ammoniacal urines we have observed repeatedly a diminution if not total disappearance of the redolence so characteristic of these unfortunates.

Many urologists resort to azo dyes only when all of the other urinary antiseptics have failed them. We have, during this study, employed an opposite policy in that we tried the other drugs only when pyridium failed. In this way we obtained data which, we believe, merit consideration.

During the last seven years we have used pyridium in over 3000 cases of urogenital infection; from this number we have been able to collect about 1500 case-records where the data are sufficiently complete to warrant an analysis of results obtained. All patients treated are from our private practice; they were seen either at our office or in our urological service at the Southern Baptist Hospital.

A tabulation shows the 1500 cases divided as follows: (a) pyelonephritis occurred in 645 or 43 per cent of cases; (b) cystitis occurred in 15 or 1 per cent of cases; (c) prostatitis occurred in 360 or 24 per cent of cases; and, (d) urethritis occurred in 480 or 32 per cent of cases. The contrast of acute and chronic lesions

was not tabulated as there appeared little difference in the therapeutic response of the two types of infection to pyridium.

In the pyelonephritis series, the average period of symptoms, prior to treatment, was one and one-half months; the period of intermittent pyridium therapy covered one month; the accessory treatment consisted in rest where pyrexia intervened, lavage of the renal pelvis with silver solution, fluids in fair quantity, keeping the bowels open, searching for distant foci of infection, autogenous vaccines in obstinate infections, in fact all of the routine procedures usually carried out in non-complicated renal infections. Of the bacteria encountered 78.3 per cent were of the Escherichia coli group and 21.7 per cent of the staphylococci group; 10 per cent of these were mixed infections of the two organism groups just named. Definite improvement or cure was effected in 61.8 per cent of patients as evidenced by culture and smears.

Table I

SUMMARY OF PYRIDIUM THERAPY IN UROGENITAL INFECTIONS

	Pyelonephritis (645 Cases)	Cystitis (15 Cases)	Prostatitis (360 Cases)	Urethritis (480 Cases)
Average duration of symptoms	1½ months	3 weeks	2 months	1 week
Period pyridium therapy	1 month	1½ months	2½ months	6 weeks
Accessory treatment	Cystoscopy	Local	Local	Local
Infecting bacteria	78.3 per cent Escherichia coli 21.7 per cent staphylococci	73.1 per cent Escherichia coli 26.9 per cent staphylococci	59.3 per cent staphylococci 29.1 per cent Escherichia coli 11.6 per cent gonococci	94.2 per cent gonococci 5.8 per cent staphylococci
End-results	61.8 per cent either cured or definitely improved as shown by culture	33 per cent negative to culture	81.6 per cent improved or negative to culture	42.1 per cent negative smears

Table II

SUMMARY OF 282 REPLIES TO QUESTIONNAIRE ON AZO DYES

	Favorable (162 Replies)	Unfavorable (120 Replies)
Used pyridium exclusively	25	13
Used pyridium plus other azo dyes	130	103
Used serenium plus other azo dyes	122	100
Used mallophene plus other azo dyes	65	40
Used niazo plus other azo dyes	70	49
Used ambazin plus other azo dyes	34	20
Employed azo dyes as adjuncts only	134	103
Employed them alone	6	3
Those who gave sufficient dosage over sufficient time	85	91
Reported effective in urethritis	73	12
Reported effective in prostatitis	57	13
Reported effective in kidney infections	123	24
Reported effective in bladder infections	100	28
Observed retarding growth of staphylococci	97	12
Observed retarding growth of streptococci	54	5
Observed retarding growth of Escherichia coli	79	10
Employed cultural check-ups	38	23
Gastrointestinal disturbances reported	51	25

Of the urethritis group, the average period of symptoms, prior to treatment, was one week. The average period of intermittent pyridium therapy was six weeks. The supportive measures followed consisted of hand injections of suitable solutions, irrigations with solutions of potassium permanganate or neutral acriflavine, instillations for deep urethral involvement, foreign protein intramuscularly or gonococcus bouillon filtrate intradermally, massage over sound for palpable infiltrations of periurethral glands, the usual routine, not omitting the instructions in sexual hygiene. Smears revealed the grama-negative diplococci of Neisser in 94.2 per cent of cases studied; 5.8 per cent were of the staphylococci group. Approximately 42.1 per cent of patients gave negative smears in from three to eight weeks.

In prostatitis we have noted most satisfactory results with the oral administration of pyridium. The average period of prostatic symptoms, prior to treatment, was two months. The period of intermittent pyridium therapy was two months with the usual accessory treatment. Gram-stained smears in these cases showed 59.3

per cent staphylococci, 29.1 per cent Escherichia coli and 11.6 per cent gonococci. After an average treatment time of two and a half months 81.6 per cent either showed marked improvement or absolutely negative smears. We study only smears of stained prostatic secretion obtained by first submitting the material to be examined to centrifugalization.

In the cystitis series the average duration of symptoms was three weeks and the period of intermittent pyridium therapy was one and a half months. Accessory therapy consisted of rest, correcting faulty elimination, searching for foci extraurinary vesical irrigations (often for distention), instillations of silver solution, urethral dilatation, fulguration to infected glands at the vesical neck, etc. Of these infections 73.1 per cent were due to Escherichia coli and 26.9 per cent to staphylococci. Here our results with pyridium were not so promising as only 33 per cent gave negative cultures at the termination of treatment. Possibly we were in error in classing even this small group as cases of cystitis. Cystoscopy was done on every patient of this group and the kidneys, ureters, urethra and cervix found negative.

Our results have been, in short, that whereas in kidney and prostatic infections the azo dye was of material value, in urethritis and cystitis its value was less marked. It is our impression that with the added help of these dyes, in combination with the established modes of treatment, we have advanced the therapeutic management of urinary infections. This we most emphatically wish to stress. We know the results obtained before the event of these dyes (employing the older internal urinary antiseptics) and the contrast is marked.

In order to determine, if possible, the attitude of urologists as regards the azo dyes, 900 questionnaires were sent out to members of the American Urological Association asking their opinion of these drugs as internal urinary antiseptics. Of the 357 total replies received, 162 or 46 per cent stated that these dyes were of value; 120 or 33 per cent believed that they are of no material benefit; 75 or 21 per cent had never tried them so could give no opinion. Thirty-eight had used pyridium exclusively; 233 pyridium plus other dyes; 222 serenium plus other azo dyes; 105 mallophene plus other azo dyes; 119 niazo plus other azo dyes; and 54 ambazin plus other azo dyes. Two hundred thirty-seven stated that they employed them as adjuncts; only 9 stated that they used them alone. Only 76 had given sufficient dosage for sufficient time to expect results. Eighty-five found them effective in urethritis; 70 in prostatitis; 147 in kidney infections; and 128 in cystitis. One hundred nine stated that they retarded the growth of staphylococcus; 59 of streptococcus; and 89 of Escherichia coli. Only 61 employed cultural check-ups. Seventy-six noted gastrointestinal disturbances following their administration. From these figures we may reasonably conclude that there is a very liberal use of dye therapy and some enthusiasm is being evidenced.

We wish to plead for a more liberal attitude toward the newer dyes in the treatment of urinary sepsis. No one with vision will acclaim the azo group as the final word on the subject. They constitute valuable stepping-stones in the path of progressive urological therapy. Through concerted interest, both clinical and experimental, a more effective chemotherapeutic medium may be found with merits superior to the compound reviewed in this communication.

SUMMARY

From our seven years' experience with the azo dyes, we have found them of definite value in combating urogenital infections. These drugs, especially pyridium (to which we confined the major part of our study), have proved superior to the older urinary antiseptics in common use. They are practically harmless in their action (apart from the anorexia and nausea occasionally observed), have a wider field

of usefulness by acting equally well in alkaline or acid urine, are synergistic to most other remedies and require no special dietary regime. Their analgesic effect upon the inflamed mucosa of the urogenital tract is considerable. They are mild deodorants. In renal and prostatic infections the results are better than in cystitis and urethritis, but even in the latter affections they are of greater value than internal antiseptics hitherto used. Some strains of Escherichia coli are retarded as effectively as staphylococci. We believe that the azo dyes merit further clinical study before they are assigned to oblivion. Investigations to determine the possible selectivity of certain dyes for special bacterial groups open vistas of untold possibilities.

Notwithstanding the great practical value of combined clinical and laboratory research, we believe there will remain much in the empirical inheritance of the dyes which will not be fully explicable by present-day investigation. Their actions and reactions within the test-tube and the utilization of their properties in therapy will not always parallel. This means that in certain uses of dyes, the value of which is attested by clinical experience, certain phenomena cannot be fully explained by laboratory tests now known. Nevertheless, such clinical observations often prove a very substantial contribution to therapeutics.

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ASSOCIATED RENAL TUBERCULOSIS AND MALIGNANCY

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ALTHOUGH numerous instances of co-existent malignant and tuberculous processes within various organs have been recorded, a study of the literature reveals a paucity of this combination of lesions within the renal area. Chomel (1814), Rayer (1841), and Rosenstein (1870), are mentioned by Ljunggren as the earliest observers of this double lesion in a kidney. However, no microscopic studies were presented. Albarran and Imbert (1903) were the first to submit a microscopic study of a case of primary renal cancer and tuberculosis. To date, 13 complete cases of these associated renal lesions are recorded. Of these, Ljunggren in 1930 and 1931 reviewed 6, adding 2 of his own. A summary of these cases is herein presented (Table 1). To this interesting series, there may be added the following case:

H. K., white male, sixty-three years of age, complained of an abdominal mass, loss of weight and general weakness. In 1912, he noticed a painful right scrotal swelling, and was subjected to an epididymo-orchidectomy. Microscopic section of the specimen revealed tubercles of the testis and epididymis.

In 1924, a painless intermittent hematuria led to a urological examination. The following were the findings as recorded by Dr. Pentlarge and Dr. Baretz (Brooklyn, N. Y.): "Patient is a highly neurotic, energetic male, aged fifty-six, but appearing ten years older. Abdomen: impression of a tender mass on the left side, possibly renal. Genitalia: penis normal; right scrotum empty; left scrotum empty (abdominal cryptorchidism). Rectal: prostate small and soft.

"Cystoscopy: slight general cystitis, urine hazy. Both ureteral orifices share in the general cystitis. Bilateral ureteral catheterization: normal flow; no obstruction on either side. Phenolsulphonpthalein test: appearance time normal from each side. Right kidney urine: clear; microscopic negative. Left kidney urine: hazy, several W.B.C. and R.B.C.; small rod-like bacilli in chains on direct smear; Ziehl-Nielsen stain: negative for tubercle bacilli.

"*X*-ray of the genito-urinary tract with catheters in situ:* (a) Left kidney: enlarged to level of 4th lumbar vertebra. *Calcareous deposits in large amounts* in what appears to be renal pelvis. (b) Right renal outline: normal size, shape and position. (c) Left pyeloureterogram: somewhat enlarged pelvis not definitely flattened or encroached upon. The patient refused further cystoscopy.

"Urine: (bladder) on another occasion contained many white blood cells, positive for tubercle bacilli and negative for other bacteria.

"Impression: left renal tuberculosis."

The patient then consulted a pioneer urologist who confirmed the clinical impression of left renal tuberculosis and also noted the calcific deposits in the lower pole of the left kidney. Operative procedure was rejected by the apprehensive patient.

In September, 1929, another *x*-ray of the genitourinary tract showed a marked increase in the size of the left renal outline. There was no evidence of the calcareous deposits which were noted five years previous. Further urological examination was again refused. The patient continued in apparently good health, conducting his daily business affairs. No bladder symptoms were present. The urine was grossly clear.

About August, 1931, the patient developed a marked asthenia and pain in the shoulder joints. He died three months later.

Autopsy disclosed the left renal mass previously diagnosed as tuberculosis to be the site of an extensive hypernephroma with a solid central mass, possessing some calcium deposit. A smear from this mass for tubercle bacilli was negative. The right kidney presented a healing tuberculous ulcer at the inferior calyx. Malig-

* Films destroyed after hazards established by Cleveland Clinic fire.

TABLE I
SUMMARY OF REPORTED CASES

Author	Year	Clinical History	Pathology
1. Albarran and Imbert	1903	Adult: aged 30. Intermittent hematuria, pyuria and pyrexia. No tbc. found	Right tuberculous pyonephrosis, numerous cavities. Upper pole had tumor size of hazelnut, with typical hypernephroma cells
2. Albrecht	1905	Adult: aged 66. Metastatic tumor of left clavicle —hypernephroma. Urine negative	Left: tumor in midportion of kidney. "Scattered in the tumor tissue are miliary tubercles, without sharp demarcation, and with destructive caseation."
3. Kyriazopolous	1906	Female, aged 57	Right kidney contained tuberculous lesions and adenocarcinoma
4. Moshowitz, Eli	1910	Male, aged 50. Right renal pain with occasional hematuria. Urine: pus but no tbc.	Right kidney pelvis presented pedunculated papillary mass, infiltrating kidney for 1½ in. Microscopic: papillary carcinoma. Pelvic mucosa: large number of tubercles with cheesy contents; no ulceration
5. Lubarsch	1925	Male, aged 54. Hematuria 2½ years	Large renal tumor. Microscopic: "Hypernephroidal and tubo-adenomatous structure with invasion by typical caseating tubercles containing giant cells"
6. Lorenzetti	1930	Female, aged 67. Weight and tumor noticed in left renal area. No hematuria. Urine turbid	Left: cavernous tuberculous pyonephrosis, associated with large tumor (7 × 5 × 4 cm.) of characteristic, hypernephroma cells; capsule about tumor contained tubercles. Associated pelvic calculus
7. Olsen	1930	Male, aged 30. Frequency, dysuria. Tubercle bacilli positive	Right kidney, small tumor at upper pole, 8 cm. diameter; no capsule. Microscopic: adenocarcinoma. Pelvis: worm-eaten tuberculous areas
8. Ljunggren	1930	Female, aged 51. Tumor: pressure and tension in abdomen. Urine: W.B.C; no bacteria. No tbc. stain made	Large unilocular cyst (man's head size) arising from anterior part of kidney. Walls of cyst lined with disintegrating tumor tissue. Microscopic: "Grawitz tumor of atypical structure. Renal parenchyma contained several tuberculous cavities, size of hazelnuts. Microscopic: scattered tubercles

Table 1 (*Continued*)

Author	Year	Clinical History	Pathology
9. Braasch, Hunt, Cooper.....	1929	Male, aged 38. Tbc. positive	Right tuberculous pyonephrosis; 70% of kidney structure destroyed by tuberculosis. Center of upper pole: adenocarcinoma
10. Clar.....	1931	Male, aged 64. Loss of appetite. No hematuria. Tumor: right lumbar region	Right side, upper pole: typical hypernephroma tumor surrounded by numerous pseudocysts. Microscopic: recent tbc. foci in marginal parts of tumor
11. Ljunggren.....	1931	Female, aged 46. Frequency, burning. Urine: Tbc. positive	Right kidney: upper pole had Grawitz tumor; no capsule. Close to tumor, three tuberculous cavities with caseous contents. Pelvis: small tubercles
12. Meredith.....	1933	Male, aged 40. Hematuria. Urine: Tbc. positive	Left kidney parenchyma: a. 3 caseous cavities (1.5 cm. diam.) b. Papillary carcinoma of pelvis (grade 1) with metastasis to ureter
13. Rupel.....	1934	Female, aged 63. Mass in left upper quadrant. Frequency and urgency. Urine: pus	Left kidney: malignancy, 7 cm. long upper and middle portion of kidney "papillary adenocarcinoma (hypernephroma type)" b. tbc. nodules over entire upper pole and one-third of entire kidney

nant metastases were found in the right renal pelvis, right renal vein, lungs, liver and bronchial lymph nodes. The necropsy report by Dr. M. Lederer* follows:

"*General:* Body is that of a well-developed and emaciated male about seventy years of age. Skin is smooth and shiny, hair is very scant over pubis; there is no hair on chest, arms or legs. The jugular veins are prominent; as are the veins of both legs. Panniculus is very thin, the musculature scant and flabby.

"*Chest:* There are no adhesions and no fluid. The lungs are smooth and shiny, black and white in color. Consistency is increased. On both apices there is a pearly puckering and scarring. Scattered throughout both lungs are varying sized spherical nodules, hard in consistency, some of which can be seen on the surface. On section they show a yellow white smooth homogeneous surface and are circumscribed. The remaining parenchyma except the left lower lobe is white and spotted black in color and dry. The left lower lobe is solid, the surface presenting a mucoid, gelatinous appearance. The bronchi and vessels appear normal. Most of the bronchial nodes are black, soft and enlarged. Others are hard and on section appear white and homogeneous.

"*Microscopic:* Lungs: Sections through the lung show large patches of fibrosis characterized by a thickening and fibrosis of the alveolar walls and the conversion of parenchyma into areas of connective tissue. In the remaining alveoli are found corpora amylacea and heart failure cells. Many of the latter approach giant cell proportions. There is also some anthracosis. In other areas there are patches of

*Grateful acknowledgement is made to Drs. Lederer and Polayes (Brooklyn, N. Y.) for their description and collection of necropsy material.

consolidation in which the alveoli are filled with fibrin and leucocytes. Some edema also occurs. Much of the unaffected pulmonary parenchyma is the seat of a marked emphysema. The submucosa of many of the bronchi is infiltrated with polynuclears and the lumen contains pus. Sections from one apex contain a fibrous tubercle with a central area of coagulation necrosis and a peripheral zone of anthracosis. The nodule in the lung is made up of two types of tissue, the predominant type being numerous alveolus-like structures containing high columnar and polyhedral cells with a clear colorless protoplasm and a small spherical nucleus. Groups of these cells are separated from one another by strands of fibrous tissue. The other type consists of papillary-like formations with cells containing a deeply staining protoplasm and hyperchromatic nuclei. Both types contain numerous large vascular sinuses which, however, are more abundant in the second type. Bronchial lymph nodes consist only of remnants of lymphoid tissue which is anthracotic. The main portion is occupied by papillary and vascular malignant growth.

"*Pericardial* sac contains an excessive amount of clear yellow fluid.

"*Heart* is normal in shape, but the surface presents a yellow jelly-like appearance. The vessels are tortuous, the proximal portions of the coronary arteries are palpable and hard. The right auricle is dilated, the foramen ovale is closed. The left ventricular musculature is flabby and soft. The tricuspid and pulmonary valves are normal. The left auricle is normal. The left ventricular musculature is soft. The mitral and aortic valves are normal. The accessory musculature throughout is flattened. The aorta shows a slight atheromatous deposit.

"*Microscopic:* Muscle fibers are swollen, and striations are not visible. There is considerable amount of brown perinuclear pigment. Aorta shows slight thickening and splitting of the intima.

"*Abdomen:* The abdominal surface is distorted by a lobulated mass which appears to the left of the umbilicus for a distance of about 8 cm. and 2 cm. to the right. On section the peritoneal cavity contains about 200 c.c. of bloody fluid. The left side of the abdomen is occupied by a large mass which weighs 2850 gm. It is lobulated and presents a variety of colors from yellow to red. It is attached to the posterior and lateral abdominal walls. Consistency varies from semi-fluid to hard. The mass had replaced the left kidney entirely and extends from the diaphragm to the pelvis. A number of abdominal viscera are adherent to it. On section it presents a honeycombed appearance and contains areas of ochre, yellow, red and white. Many of the spaces are filled with blood.

"Stomach wall is thick, the rugae are prominent, the mucosa shows a mosaic appearance. The duodenum and papilla of Vater appear normal. The jejunum and part of the ileum are adherent to the mass. The small intestines are normal. The large intestine is normal. The upper portion of the descending colon, the splenic flexure and the distal half of the transverse colon are intimately adherent to the tumor. The retroperitoneal lymph nodes are enlarged, soft and pink.

"*Microscopic:* Stomach mucosa is the seat of a patchy edema with some round cell infiltration.

"*Liver* weighs 2000 gm. The shape is normal except the quadrate lobe which contains a large globular mass projecting from its surface. The capsule is smooth and glistening; the consistency is normal. On section the parenchyma is mahogany colored. The nodules vary much in size, are well circumscribed. Some are hard, yellow and homogeneous on section. Others are soft, and made up of trabeculated soft tissue containing fluid blood. Periportal lymph nodes are enlarged, soft and black. Bile passages are normal. The gall bladder is distended and contains dark green bile. Portal vein is normal.

"*Microscopic:* The architecture of the organ is distorted by the presence of nodules of malignancy similar to those already described. The liver cells in the region of the growths are compressed and in many places there exists a zone of round cells between the malignant growth and the hepatic parenchyma. The liver cells elsewhere are swollen and granular. Capillaries are greatly dilated. The portal veins are enormously distended. Areas of focal necrosis are found. There is a slight amount of round cell infiltration in the portal connective tissue. Periportal lymph node is the seat of some hyaline degeneration. Bile accumulation in the macrophages is found.

"*Pancreas* weighs 58 gm., is very flat and thin and of bright yellow color. About one-

third (the tail) is intimately adherent to the mass.

"*Microscopic:* The islands of Langerhans are large and irregular in shape and appear hyperplastic.

"*Spleen* weighs 164 gm. Capsule is purple in color and smooth, and consistency is firm. On section the capsule is thickened, the parenchyma is purple in color, and markings are distinct.

"*Microscopic:* The normal architecture is well preserved. The lymph follicles are few and small. The pulp—the sinuses are greatly distended and lined by a cuboidal type of endothelium. The sinus walls are thickened. The appearance resembles that of an adenomatous structure.

"*Adrenals:* The left is present as a very small (about 2 gm.) dark green flat structure, with a very thin cortex and no visible medulla. The right weighs 6 gm. On section the cortex is bright yellow in color; the medulla is abundant.

"*Microscopic:* Normal.

"*Kidneys: Right* weighs 194 gm. The left cannot be found. On section the capsule strips easily and cleanly leaving a smooth red surface, excepting near the pelvis where it is white. On section the cortex and medulla appear normal. One inferior calyx is dilated and surrounded by a hard green black border. The mucosa here is red and thickened. The renal vein contains a stringy attached mass which can be traced to a rather large white firm tumor in the pelvis. The right ureter is normal. The left ureter can be traced for a distance of about 4 cm. from the ureteral orifice in the bladder, and then merges into tumor tissue where no further trace of it can be discovered. The renal and adrenal vessels otherwise are not involved.

"*Microscopic:* Right: The glomeruli are hyperplastic throughout. The tubules are dilated. A papillary form of the tumor is found in a large branch of the renal vein. Gross examination of the cavity described shows that it is surrounded by a granulomatous structure in which there are found numerous giant cells, epitheloid tissue and round cells. The tumor mass on the left side in sections from the central solid portion shows it to consist of a structureless fibrous tissue mass containing no nuclei whatever. In it can be recognized the remains of thrombosed blood vessels and spaces. There is some deposit of calcium in this mass. The tumor proper consists of the two types of tissues described above. The amount of connective tissue, however, both in the tumor and in the alveolar spaces is greater and there are many areas of abundant vascularity.

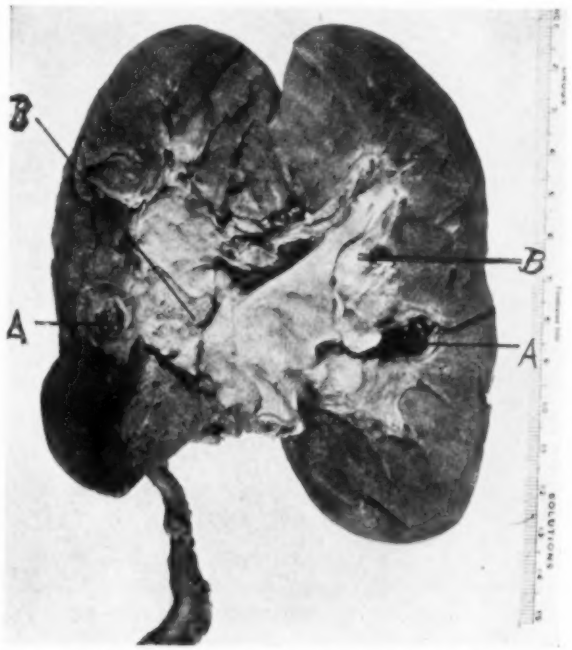

Fig. 1. Right kidney. A. Tuberculous ulcer. B. Malignant mass (metastatic) in pelvis.

"*Bladder and prostate* normal.

"*Genitalia:* No testes can be demonstrated in the scrotum.

"*Spinal column:* Section of the spinal column is free from metastases.

"*Rib marrow* is bright red, thick and abundant.

"*Bone marrow:* microscopic normal.

"*Anatomical diagnosis:* (1) Hypernephroma of the left kidney with metastases into the right renal vein and kidney, lungs, liver and bronchial lymph nodes; (2) Portal obstruction; (3) Splenomegalic cirrhosis; (4) Healed pulmonary tuberculosis and healing renal tuberculosis; (5) Bronchopneumonia; (6) Emphysema; (7) Chronic bronchitis; (8) Brown atrophy of heart; (9) Chronic catarrhal gastritis."

COMMENT

Interest in this case centers about two points: One notes the development of a malignancy within a definite phthisic constitution, as evidenced by the healed

pulmonary tuberculosis, the healing right renal tuberculosis, and the right tuberculous epididymo-orchitis. The second phase of interest is concerned with the possible development of the left renal malignancy within an already tuberculous area. As evidence of this contention, one must consider the original extensive calcific deposit in the renal area, associated with a microscopic picture of round cell infiltration and fibrosis. Giant cells were found scattered throughout several malignant areas. Pus, blood, and rod-like bacilli were also isolated from the left side. Another point at issue is a satisfactory explanation for the almost complete disappearance of the extensive calcific deposit within a period of five years (as evidenced by *x*-ray). Although not generally recorded, hypernephromas can have sufficient calcific deposits to render a roentgenological picture, simulating very closely the characteristic shadows of tuberculosis. Braasch, in a personal communication, reports at least 15 or 20 cases of hypernephromas in which the *x*-ray showed definite areas of calcification. These were confused, in several instances, with tuberculosis.

Fig. 2. Left renal mass (hypernephroma). A. Central hard core.

Absorption of primary calcification within a tumor has never been noted by reputable pathologists to whom this matter was referred. Displacement of calcific material, as of tuberculosis, by malignant invasion, similarly, appears to be a very rare occurrence. Ewing has never observed the actual absorption of calcific deposit either within a cancer or in tissue invaded, but concedes the probability by stating, "I see no reason why some of the processes that go on in cancer tissue might not result in absorption of calcific material. We know that bone is often absorbed by cancer, etc. The same absorption occurs also in portions of osteogenic sarcomas."

F. W. Stewart states:

> I do not see any reason why it should not occur. In rapidly growing osteolytic tumors one sees extensive decalcification presumably following interference with the blood supply by tumor cells invading the Haversian canals. It is more difficult to explain the occurence of osteoplastic metastases with the laying down of calcific deposits and bone about metastatic areas in bone. I have repeatedly seen metastatic lymph nodes, surrounded by a shell of calcium or even of true bone. There are instances of true osteogenetic bone sarcoma arising in the bone deposit of old phthisis.

Broder believes that "this condition could take place in the case of certain low

grade functioning carcinomas." Carl Weller, in response to the query, could not recall any specific cases, but said that: "Judging by the ease with which lime salt is removed from bone, both normal and pathological under the influence of an infiltrating neoplasm, I would expect that other lime salt deposits might be similarly attacked."

W. G. MacCallum has never noted such a process but feels sure that "it will be possible to observe the absorption of that (calcification) in the advance of a tumor but whether it is done by the tumor cells or in some other way remains a question."

Warthin (1898) described a case of breast cancer with axillary metastasis into a node already the seat of active tuberculosis.

Moak (1902) reported a case of adenocarcinoma of the sigmoid flexure, secondarily infected with tuberculosis and metastasis of both lesions to the left kidney. He also described a carcinoma of the prostate in a case of pulmonary tuberculosis with subsequent involvement of lymph nodes, adrenal, spleen, etc. by both processes.

Of the 13 cases noted, renal tuberculosis was associated with hypernephroma in 8, with adenocarcinoma in 3, and with papillary carcinoma of the pelvis in 2. In 5 cases, the extent of the tuberculous lesions was grossly equivalent to the size of the malignancy. In 2 cases, the tuberculous process greatly exceeded the malignancy. In 7 cases the malignancy was the predominating factor. Consequently, one notes all stages of activity and growth of these two lesions. The clinical picture was dominated by the malignancy in 7 cases, and by tuberculosis in 5.

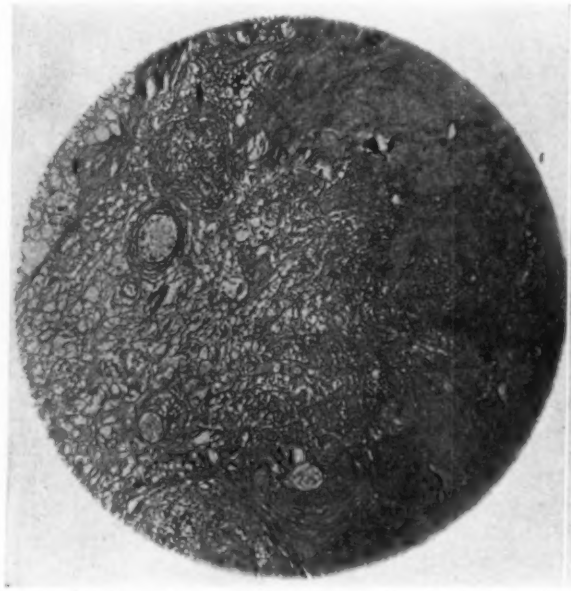

Fig. 3. Section from central mass. Associated with this area were round cell infiltrations and fibroblasts. Giant cells were found scattered throughout malignancy.

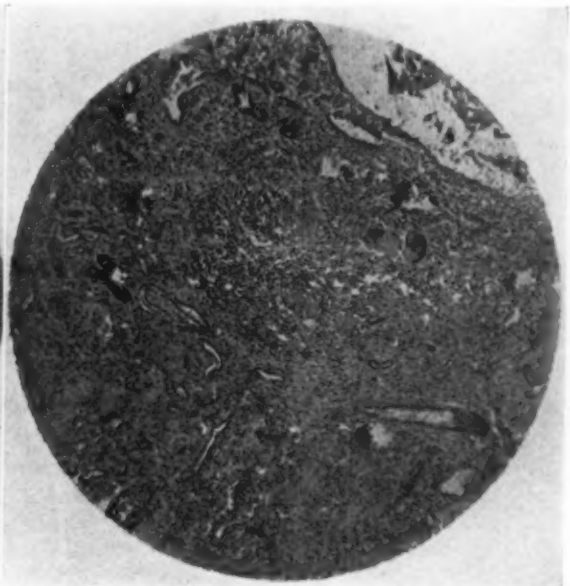

Fig. 4. Section from tuberculous ulcer of right kidney.

Cooper, utilizing Broder's classification, found that all degrees of malignancy can flourish with tuberculosis.

Ljunggren is of the opinion that the relationship of renal malignancy and tuberculosis is merely coincidental. He, however, submits the view that a disturbance of circulation at the periphery of a tumor might afford a point of weakened resistance, which in turn would provide the soil for tuberculous invasion. Five cases of this series seem suited for this hypothesis. Three cases, however, had the tumor area widely separated from the tuberculous focus. In those cases of extensive tuberculous involvement with a small adjacent malignant area, one must bear in mind

Cherry's experimental work. He showed that a tuberculous lesion can induce a progressive, proliferative stimulation as evidenced by epethelioid formation. Hueper also points to the fact that tuberculosis "has a known tendency to extensive lymphoid hyperplasia." Warthin, Zenker and Ribbert have viewed such cellular activity as reasonable excitant agents of malignant change. A sub-epithelial proliferation has been considered the basis of this metaplasia. Lubarsch reviewing thousands of cases noted that carinoma may arise in a chronic progressive tuberculous lesion, in a manner similar to that of acute or chronic trauma favoring malignant changes. However he also noted the association of the two lesions along the following lines:

1. As purely accidental (one-half the cases.)

2. As a metastatic cancer in or near old fresh tuberculous lesions. Through the cachexia of cancer new tuberculosis eruptions may follow old lesions (not rare).

3. As a fresh infection of tubercle bacilli, occurring in a well-developed carcinoma (rare).

Speculation as to the causal relationship of carcinoma and tuberculosis was created by Bayle's (1910) observation of the two processes within the lung. Rokitansky (1846) as the result of extensive pathological study stimulated interest in this question by concluding that the presence of one process generally signified the absence or retardation of the other. Thus the theory of an antagonistic relationship was established. Since then the subject has been one of considerable controversy. Statistically, the extensive necropsy studies of Lubarsch, Suzur, Pearl, Roth and others favor this conception. However, Carlson, Bell, Fortune (1925), studying thousands of cases present equally convincing conclusions to the contrary. Experimentally, workers (Centanni and Rizzei; Teutschlender), have shown the retardation or complete regression of malignancies upon the introduction of tubercle bacilli in one form or another. On the other hand, Cherry actually noticed, that, experimentally, the incidence of skin malignancies in mice rose to a high percentage (55–70 per cent) upon the introduction of a small number of tubercle bacilli. Harde and Fascea, working on spontaneous carcinoma and sarcoma of mice, found no regression in the activity

Fig. 5. Section from left hypernephroma.

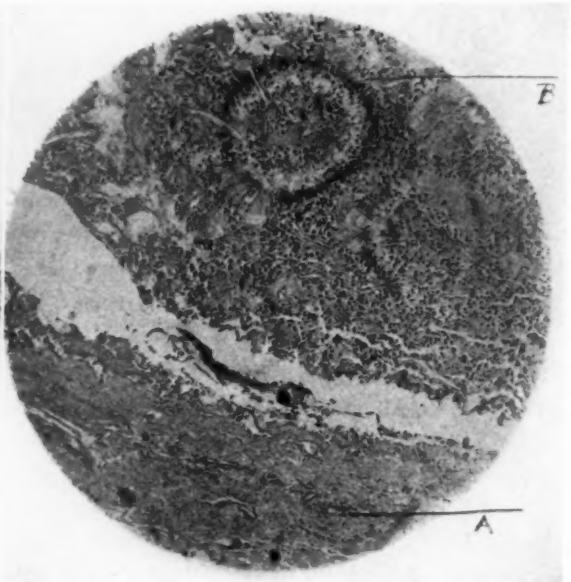

Fig. 6. Section from right renal vein. A. Vein wall. B. Malignant tissue.

of the malignancy in the presence of active bovine tubercle bacilli. Furthermore, a comprehensive clinical survey by Cooper demonstrated hundreds of cases with co-existent malignant and tuberculous lesions of all degrees in various systems of the body.

Consequently, with statistical, experimental and clinical studies so contradictory, many observers (Benke, Pende, Baar) are inclined to doubt the existence of an antagonistic role per se, but rather view the predisposition of these diseases on a constitutional basis. Essentially, the cancer patient is the hypasthenic patient whose anatomical high points are a well-developed heart, a wide or too wide arterial system, small lungs, well-developed liver, muscle and bones. The asthenic individual with opposite anatomical features, possessing some sort of antiblastic factor, affords fertile soil for tuberculous development. Epileptics with hyoplastic vascular system, persistent thymus and degeneration stigmata, have, as shown by Vollard, a very low cancer death rate (1.1 per cent of 540 autopsies). For those individuals with a double lesion, Benke offers the conception of hybrid constitution susceptibility.

SUMMARY

1. The pathogenesis of associated renal tuberculosis and malignancy is discussed. Although their dual occurrence seems to be coincidental, future cases should be studied from a constitutional viewpoint.

2. The similarity of the *x*-ray appearance of malignant and tuberculous (renal) calcification is noted.

3. Thirteen cases of unilateral renal malignancy and associated tuberculosis are reviewed. A case of right renal tuberculosis and left hypernephroma is presented. Evidence is offered toward the supposition that the original lesion in the left kidney was of tuberculous origin.

4. Ten of these cases have been reported since 1925. This would indicate that one must consider the coexistence of these lesions in the urinary system with more than passing interest.

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AVERTIN RECTAL ANESTHESIA

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THIS report is based on a survey of 868 administrations of avertin on the surgical services at the Atlantic City Hospital since its introduction in 1930, with a critical review of 200 cases. From the beginning we have insisted on its use as a partial or basal anesthetic. We have had an occasional case of complete anesthesia, which must be explained on the assumption that there is a varying individual susceptibility, the same as with ether, alcohol and other narcosis agents.

During his hospital internship and since, one of us (V. E. J.) had considerable experience with the ether-oil rectal method. As to the safety factor of this method as compared with avertin, more is to be considered than the difference in the rate of absorption from the rectum, and, after all factors were considered, the authors have eliminated ether-oil from their anesthesia list since becoming acquainted with avertin. We are of the opinion that avertin and ether-oil colonic anesthesia have about the same degree of immediate anesthetic safety and that ether by rectum has two disadvantages, namely (1) secondary pulmonary complications; ether is to a great extent eliminated from the body through the lungs, and (2) the ritual of administering ether per rectum makes it objectionable to hospital routine. The objections raised against rectal anesthesia in general are more theoretic than practical.

At the present time avertin is supplied in the form of a liquid, amylene hydrate fluid being the vehicle, and 1 c.c. of the amylene hydrate solution contains 1 gm. of the crystals. Amylene hydrate has a mild hypnotic action and, therefore, the solution acts slightly more as a narcotic than does the earlier crystalline preparation. It is also important to remember that amylene hydrate is a respiratory stimulant.

INDUCTION

The usual induction is quiet, smooth and rapid. After a few minutes the eyes close, the patient responds languidly to questions and consciousness is frequently lost in the middle of a sentence a few minutes after the injection has been started. It is unusual for its completion to require over ten minutes.

The degree of narcosis obtained from the injection determines the amount of the supplementary anesthetic required to augment the depth of the anesthesia to so-called "surgical anesthesia." This auxiliary anesthetic can be increased, decreased or withdrawn at will. Ether and nitrous oxide, in their influence on blood pressure and respiration, are opposed to the action of avertin, while both act in the same direction to secure anesthesia.

Only a very small amount of additional inhalation anesthesia is used, and local anesthesia works especially well in conjunction with avertin anesthesia.

PHYSIOLOGY

Avertin is absorbed from the rectum very rapidly: 50 per cent in the first ten minutes and 75 per cent after twenty minutes and then very slowly. The curve of absorption is therefore very sharp in the beginning, but becomes practically flat later on. The water, in which the avertin fluid is admixed, is absorbed much more slowly: 25 per cent in the first ten minutes and when the anesthesia is complete only 33 per cent of the water is absorbed. There-

fore the concentration of avertin in the water determines in a large measure the rate of absorption.

There is unanimity of opinion that elimination takes place almost entirely through the kidneys and liver, and possibly a small amount through the intestinal tract. Pulmonary elimination, if any, is too slight to consider. After four to eight hours from 80 to 100 per cent can be demonstrated in the urine. Avertin is converted in the liver, forms a compound with glycuronic acid and is eliminated through the kidneys.

Our own studies show that avertin does not depress kidney function. There is a lessened fluid output, but there is no influence on percentage elimination of phenolphthalein. Irritation of the kidney parenchyma occurs to such a slight degree that only one case presented a pathological amount of albumin (over 5 mg. per cent) as shown by urinalysis. No red cells were found on urinalysis. Blood chemistry studies revealed a very slight decrease of CO_2 combining power as the only constant deviation. Blood sugar estimations were as frequently lower as they were higher. The nitrogenous elements were unchanged.

Blood pressure is lowered, usually about 20 points, shortly after administration, but usually begins to rise again in about twenty to thirty minutes. The pulse is elevated in proportion to the drop in systolic pressure.

The respirations are made shallow and are slowed in rate.

Muscular relaxation, with the addition of a small amount of ether, is especially noted. In fact, the relaxation approaches that obtained with spinal anesthesia.

The eyes become fixed early, the pupils contract, but react to light and the cornea loses its reflex early. Absence of corneal reflex cannot therefore be used as an index of the depth of anesthesia.

Because elimination does not occur through the respiratory system there is no irritation of the lungs.

RECOVERY PERIOD

The usual period of unconsciousness varies from two to four hours and reaction is usually smooth. The patients seem to sleep quietly after operation and when awakened they immediately fall into a sleep again. Occasionally a patient becomes irrational and a little later may become almost unmanageable. We routinely administer a hypodermic of morphia gr. $\frac{1}{6}$ to $\frac{1}{4}$ as soon as the first signs of restlessness begin and have found that this will prevent delirium and violent reactions.

POSTOPERATIVE COMPLICATIONS

1. There is one serious accident which may happen during the postoperative period. Avertin anesthesia causes an early and prolonged relaxation of the masseter muscles and tongue and, as a consequence, a dropping of the lower jaw. This favors "swallowing of the tongue." If this occurs the patient may become asphyxiated. This is prevented by (1) placing the patient in bed with head turned far to one side and (2) having an attendant present to see that the head is kept in that position. If the head is kept turned there will be no trouble from this source. If the tongue does fall back it must immediately be pulled forward with a tongue clamp or towel clip by the attendant. After the patient has reacted and pharyngeal reflex has returned no further anxiety need be felt on this score. The accident can also be prevented by placing an air-way in position until reaction occurs.

2. Respiratory depression sufficient to cause concern occurs in about 2 per cent of cases. In our experience it has been practically limited to patients who have had an anorectal operation. Two patients required artificial respiration and an intravenous injection of 1 or 2 c.c. of coramine. The latter seems to have almost a specific effect under these conditions.

3. Vomiting has always been a complication of abdominal operations and is most

dreaded by prospective patients. The vomiting that does occur from the anesthetic per se is not persistent. Only 3.5 per cent of patients vomited over three times.

4. Postoperative gas pains have, according to the nurses in attendance, been very much reduced in frequency. Of 200 cases reviewed only 13 cases persisted after the second day. The routine second day enema put an end to complaints except in those 13 cases.

5. Urinary retention occurs about as frequently as after ether anesthesia. Of the 200 cases reviewed 46.5 per cent required catheterization. This is far from being the real retention rate after avertin, because 74 of these 93 cases had been subjected to a gynecological operation and that service has a routine of catheterization every eight hours. In the field of general surgery the necessity for catheterization is less than after ether anesthesia.

6. Bronchitis, pneumonitis and pneumonia occur with far less frequency than following ether anesthesia. We have had no case of pneumonia when avertin alone was given or when combined with local. We have had one case of lobar pneumonia occur following cholecystectomy under avertin with nitrous oxide and ether augmentation. Bronchitis occurred in 11 cases of the 200 reviewed. Postoperative massive pulmonary collapse was not observed in this series.

INDICATIONS

Broadly speaking avertin anesthesia can be used in the entire domain of surgery. Any anatomical region can be attacked under this form of anesthesia. There are no absolute indications for its use, but it would seem to be especially useful in the following:

1. Highly nervous and overwrought patients.
2. Those who have previously suffered much from other forms of anesthesia.
3. Patients with cardiac disease.
4. Those who dread an anesthetic.
5. Surgery about the head or neck, so that the anesthetist can be kept out of the way. Combined with local anesthesia it is the ideal combination for this region.

There are no physiological reasons for using avertin as exist, for instance, for spinal anesthesia; therefore there are no absolute indications.

We have used it in acute abdominal conditions as well as in "elective operations" for chronic conditions. We feel that avertin should only be used for grade A and B surgical risks, which represent good and fair risks respectively.

CONTRAINDICATIONS

We do not use avertin under the following circumstances:

1. Renal disease: Calculus disease, definite nephritis, suppurative diseases of either kidney.

We are aware that some writers report its use in unilateral kidney lesions (Specht), mild nephritis and prostate disease (Schildbach) with apparently successful results. We cannot share this view at the present time, because there is unanimous agreement that the kidneys are the principal outlet for decomposition or metabolic products of avertin. We feel that nitrous oxide and oxygen combined with ether, if necessary, or spinal anesthesia, is safer. After all, it is not a question of under how many conditions one can use a certain kind of anesthesia; in these cases it is a choice of the lesser evil.

2. Hepatic disease, when there is reason to believe that liver function is definitely impaired, as seen in cases of obstructive jaundice, carcinoma of gall bladder or liver, cirrhotic liver and peritoneal ascites. Ordinary gall-bladder surgery does not contraindicate the use of avertin.

3. Acute respiratory disease or chronic respiratory disease, when the ventilating surface is markedly reduced. While avertin does not produce irritation of the pulmonary parenchyma, the very life of the patient depends upon satisfactory and sufficient pulmonary aeration.

4. Debilitated states and dehydrated patients and patients in shock all contraindicate avertin. The selection of an anesthetic in these cases is always attended with difficulties and at present reliance upon nitrous oxide and local anesthesia, either separately or combined, seems probably the best.

5. Diabetic patients requiring surgery, even controlled cases, present the hazard of developing acidosis and postoperative hyperglycemia. Avertin does not produce either of these, but the anesthesia lasts so long that starvation acidosis may develop.

6. Rectal disease proximal to the internal sphincter contraindicates avertin. This does not, however, hold true for hemorrhoids, fissures and uncomplicated fistulas.

DOSAGE

Since its introduction we have never exceeded 100 mg. per kilo of body weight and regardless of how heavy an obese patient, we have set 8 gm. as the maximum dose. We have tried 80, 90, and 100 mg. doses and find that the 90 mg. dose is the best for the average patient and for children up to fifteen years of age. For elderly patients we feel that 80 mg. per kilogram of body weight is the best dosage. We insist that the patient be weighed after admission to the hospital and that the patient's statement of weight is not to be accepted.

Preliminary medication with morphia hypodermically has been discarded in our hospital except for rectal cases.

MORTALITY

Deaths from avertin anesthesia per se, when the dosage has not exceeded 100 mg. per kilo of body weight or 8 gm. as a total dose for obese individuals, have not been discovered in the literature reviewed. No doubt, there have been some deaths from the anesthetic alone that have not been reported and possibly we have missed some reports in which deaths were recorded. Those deaths that we have come across were reported by Bloomfield and Shipway, W. Burk, Kallman and Goldschmidt and Hunt.

REVIEW OF DEATHS IN ATLANTIC CITY HOSPITAL

(200 cases reviewed)

Case 4476. E. R., female, aged fifty years, regarded as grade A risk. Operation for small intramural fibroid, supravaginal hysterectomy and a bilateral salpingo-oophorectomy. Patient weighed 94 pounds and was given 100 mg. avertin fluid per kilo. No preliminary hypnotic. Patient reacted from anesthetic three hours after administration. Died fourteen days after operation. Postmortem showed pelvic abscess.

Case 2066. E. Del M., male, aged thirty-nine, regarded as grade A risk. Weight 154 pounds. Given 90 mg. per kilo without preliminary hypnotic and with nitrous oxide and ether supplementary. An easy cholecystectomy and appendectomy performed. Reacted from anesthetic within three hours. Hiccough present as soon as reacted. Course stormy for immediate postoperative period, expectorated bloody mucus next day and diagnosis of lobar pneumonia was made. Death on fifth postoperative day from pneumonia.

Case 1260. M. C., female, aged fifty-two, regarded as grade B risk. Sent to hospital as case of acute intestinal obstruction, which was improved by enemas and diagnosis of possible carcinoma of sigmoid was made. Operation third day after admission using 110 mg. of avertin per kilo, supplemented by nitrous oxide and oxygen. Operation revealed mass in sigmoid, which was resected and end-to-end anastomosis done. Reacted from anesthetic within four hours. Patient regarded in good condition, although complaining of abdominal pain and vomiting until the sixth postoperative day. Died seventh day postoperative, apparently from retroperitoneal cellulitis.

Case 1533. J. H., female, aged twenty-nine. Operation under 90 mg. per kilo of body weight. Diagnostic curettage, cervical repair, Gilliam suspension of uterus. Pulse rate began to increase as soon as returned to ward. Reoperation seven hours later to control intraperitoneal secondary hemorrhage. Died on seventh postoperative day as a direct result of the hemorrhage.

Case 3452. Mrs. E. W., colored, aged forty-seven. Had severe diabetes mellitis associated

with multiple fibroids which were causing much painful suffering and loss of weight. Blood sugar 360 on admission, 118 the day before and 135 the morning of operation. Given 90 mg. avertin with nitrous oxide and ether supplemental and a difficult hysterectomy done. Patient left operating room in severe shock. Patient reacted, however, but was never in good condition. The postoperative blood sugar was 304 (next A.M.) and was kept under ordinary control with insulin, but she was not doing well. Death eighteen days after operation from diabetic acidosis. No autopsy.

It is obvious that the death rate from avertin is yet to be computed. Certainly there must be some deaths from any agent which has the power to render individuals unconscious.

In 1930 Guttman stated that the anesthetic risk that is intrinsic in this anesthesia is about 3 in 10,000. We are not sure where he obtained this information, but we presume that it is based upon European statistics, because avertin had just been introduced in this country at that time. It is well known that the dosage abroad was from 90 to 180 mg. per kilo of body weight and that 0.125 gm. was the usual routine in Europe. Because of the smaller doses in this country we feel that the foregoing death rate has no application in this country.

CONCLUSION

Our experience with avertin anesthesia has been most gratifying and satisfactory. We believe it to be the most humane anesthetic yet devised. Patients are even more impressed. The reaction of the surgical staff to the anesthesia problem is reflected by the fact that the number of cases in which it has been administered has increased each year in the Atlantic City Hospital. We have been trying during this period to get away from routine in anesthesia and instead to fit the anesthetic to the patient, his particular pathology and his temperamental make up. We feel that there is justification for the inclusion of avertin among the list of recognized anesthetics and believe that it has brought us a step nearer perfect anesthesia induction.

SUMMARY

1. Our experience with 868 administrations of avertin is given. A critical review of 200 cases is undertaken.

2. This communication reveals the physiology, postoperative complications, indications, contraindications, dosage and mortality of avertin anesthesia.

3. A review of the deaths in the 200 analyzed cases is presented.

NOTE: Since the above data were assembled we have had one death which we attribute to avertin. This occurred approximately forty hours after an operation to place a bone-block from the os calcis between the tibia and astragulus posteriorly to correct a drop-foot caused by infantile paralysis. The patient was thirty years of age and was given 90 mg. per kilo. Respiratory difficulty and circulatory collapse developed almost twenty-four hours after operation and the patient became unconscious. At this stage 2 c.c. coramine were given intravenously and within five minutes the patient was awake and conversing normally and the respiratory rate had increased from 9 to 16 excursions per minute. He was thought to be out of danger by the writer (V. E. J.) who had been called to see the case. Orders were left to give 2 c.c. more of coramine every hour for five hours and specific and emphatic instructions given that morphine should not be given again. The latter was violated on the part of the surgeon in charge. We are of the opinion that this patient's respiratory center had been left partially damaged by infantile paralysis so that it was particularly vulnerable and in the future we would advise against its use on such cases. We must however class this as an avertin death and at the same time warn against the use of morphine in cases that have shown a decided respiratory embarrassment.

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[For Remainder of References see p. 535.]

SPLANCHNIC ANESTHESIA

ITS IMPORTANCE IN OPERATIONS OF THE UPPER ABDOMEN

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IN the last ten years local and lumbar anesthesia, in numerous modifications, have often replaced general anesthesia in abdominal surgery, with satisfactory results.

For operations in the lower abdomen spinal anesthesia can be resorted to without much danger; but for surgical procedures in the upper abdomen the anesthesia produced by subarachnoid block must, in order to be adequate, reach as high as the sixth thoracic vertebra to render all branches of the splanchnic nerve insensitive. Since high spinal anesthesia is not without great danger, many surgeons refuse to employ it.

One of us (Finsterer) reported on anesthesia in abdominal surgery at the Centenary celebration of the British Medical Association, in July, 1932. Here, data were recorded from 120 German surgeons operating in larger hospitals concerning their methods of anesthesia and the results obtained, especially in the high spinal form. Only 19 of the 120 surgeons made use of the high lumbar anesthesia, and of these 5 have abandoned its use because of frequent failure. Neither did Pitkin's method offer any solution to the problem of avoiding disaster; Demel of the Eiselsberg Klinik experienced 2 deaths in 250 cases and promptly abandoned this method.

The girdle type of lumbar anesthesia used by Kirschner serves the purpose well. However, its technique is rather complicated and it can, therefore, scarcely be recommended for general use. Commenting on this method, Verebelyi records one fatal case in his own practice and 2 other fatalities in the hands of other surgeons in Budapest.

Paravertebral anesthesia, which has been very successful in colon resections, cannot be recommended in surgery of the upper abdomen because of the multiplicity of punctures necessary (twelve to eighteen) along the spinal column, as well as the danger of too rapid resorption of large amounts of novocaine to which the patient is subjected. Its purpose is to interrupt the rami communicantes of the sixth to twelfth dorsal as well as the first and second lumbar segments. Since the former unite to form the major and minor splanchnics, it is much simpler to interrupt the main trunk by splanchnic anesthesia instead of attacking the individual rami.

The splanchnic nerves are situated in the loose cellular tissue of the posterior mediastinum at the lateral sides of the vertebral column and pass through the crus of the diaphragm into the retroperitoneal space of the abdominal cavity. Here they join the celiac ganglion, whence the postganglionic fibers travel to the stomach, the small intestine, the large bowel, and some fibers even reach the rectum by way of the superior mesenteric ganglion.

The novocaine solution is never injected into the nerve structure proper but into the surrounding tissue, anesthesia by diffusion being the aim. The technique may be accomplished in one of two ways, either the dorsal route according to Kappis is chosen, or the abdominal route of Braun.

Formerly the dorsal method was used almost exclusively, even after one of us (Finsterer) demonstrated the advantages of the abdominal route for splanchnic anesthesia in America ten years ago. Because of alleged great danger the dorsal

method was soon abandoned in favor of the abdominal one. Meeker reported in 1925 one death in 343 cases of splanchnic anesthesia by the dorsal method.

In 1927 Takáts collected 2475 cases with 8 deaths, 4 of which could not be ascribed to splanchnic anesthesia. The first of these cases was that of Kutscha-Lissberg who, in addition to the splanchnic anesthesia, performed a high lumbar anesthesia in a patient with peritonitis of three days' standing due to a rupture of the ascending colon. Since there existed in this case a far-advanced peritonitis, death was not caused by the high lumbar anesthesia and had nothing to do with splanchnic anesthesia. In the case of Jirasek a high lumbar anesthesia was performed in addition to the splanchnic anesthesia, and here death must be ascribed to the dangers of the high lumbar method. In a death resulting in one of Denk's cases he attributed the fatality not to the form of anesthesia but to the advanced peritonitis. Also, Graf's patient was operated upon for an acute intestinal occlusion (cecostomy) in a state of shock, splanchnic anesthesia being used. This was a faulty indication, since local anesthesia of the anterior abdominal wall would have sufficed for so simple a procedure as a cecostomy, splanchnic anesthesia having no effect upon this region.

In 4 other fatalities death has been erroneously credited to splanchnic anesthesia. Two of these were due to faulty technique (Heller and von Klautz) the patients having expired during injections of the solution, which were either intravenous or interlumbar. If splanchnic anesthesia is performed, not as recommended by Kappis, in the reclining position, but with the patient in a sitting posture a lateral subarachnoid injection is not likely to occur because immediately upon entrance of the needle into the subarachnoid space spinal fluid will issue by reason of the increased pressure while the patient remains sitting. Placing the patient in the upright position also tends to eliminate intravenous injections. Borszéky injured the suprarenal gland during the course of injection, as was revealed at necropsy. In a death reported by Graf a dose of 100 c.c. of ½ per cent novocaine solution was used which, according to our experience, is too great an amount.

In the 5895 cases of splanchnic anesthesia performed according to Kappis which have been collected from surgeons and from the literature, excluding the 4 cases that were recorded in the first years of splanchnic anesthesia, the maximum death rate was calculated at about one in 1474, and not one in 343 cases.

If we follow Specht's method of calculating the death ratio, which excludes those deaths due to faulty technique (avertin narcosis), then our calculation would be one death in 5895 cases. Kappis himself reported no fatality in 1500 cases, and Hustinx reporting in 1924 had no death in his 663 cases. Hilarowitz (Lemberg), using Roussie's modification, in which the needle is inserted above the twelfth rib into the posterior mediastinum, reported no accident in 785 cases.

In view of these facts it may be asserted that Meeker is wrong in contending that splanchnic anesthesia is a dangerous method and therefore cannot be applied. His paper of eight years ago, from the Mayo Clinic, is not based upon personal experience but on data collected from the literature. It is earnestly hoped that the erroneous death ratio of one to 343 still occasionally quoted (Schroeder et al.) will disappear as a fallacious citation should, and the more accurate figures of one to 1474, or even one to 5895, will be substituted.

Anterior splanchnic anesthesia as recommended by Braun is stated to be less dangerous, since no deaths from the anterior approach have been recorded up to the present time. One of us (Finsterer) reported in 1926, at the meeting of the British Medical Association, on 2373 cases collected from the literature and personal communications from several

German surgeons, without a single fatality. The difference in the danger of both methods lies in the fact that in anterior splanchnic anesthesia an intralumbar injection is impossible, and an intravenous injection can be avoided by ascertaining the exact location of the needle. There remains, therefore, as the only possible danger an intoxication from too rapid resorption of the anesthetic, or perhaps from overdosage.

In anterior splanchnic anesthesia the needle is inserted through the open abdominal cavity onto the anterior surface of the twelfth thoracic vertebra, between the aorta and inferior vena cava. In thin individuals this is easily accomplished, while in stouter persons, and in those with adhesions, it is at times more difficult and painful. In such cases the procedure may be rendered painless by a short ether or nitrous oxide narcosis, which permits the needle to be introduced painlessly.

Our technique of splanchnic anesthesia is as follows: Having anesthetized the abdominal wall by infiltration of novocaine in the usual manner, the left lobe of the liver is gently elevated by means of a retractor, preferably one of the long anterior vaginal type. With his right hand the surgeon then draws the stomach downward, thereby tensing the lesser omentum. With the left index or middle finger he palpates for the pulsation of the hepatic artery near its origin from the celiac axis, above which the lesser omentum is pressed against the body of the vertebra, thereby feeling the pulsating aorta along the radial border of his finger. To render the lesser omentum painless it is desirable to inject it near the cardia and deposit 10 c.c. of a novocaine solution. By means of the finger the aorta is now separated from the inferior vena cava. Thus the aorta deviates to the radial side of the finger, or to the left side of the patient, while the inferior vena cava is displaced towards the ulnar border of the finger, or the right side of the patient. A needle 15 to 20 cm. long is then introduced just above the index finger until it reaches the twelfth thoracic vertebra. Since the aorta is elastic and is also protected by the finger it cannot be injured. Only the inferior vena cava may be traumatized. This may occur when it is fixed in the retroperitoneal space by numerous adhesions, and while the finger is compressing it an inadvertant puncture of the vessel may result. To avoid this accident the needle should never be guided over the middle of the finger or its ulnar border; it must follow along its radial edge. As soon as the needle comes in contact with the vertebra the injection is begun, but before beginning it is imperative to ascertain whether or not the needle has entered a small vein. If no blood returns in the barrel of the syringe during aspiration the injection is slowly started. Since the needle may be displaced by regurgitation or respiration, thus inadvertently entering a vein, repeated aspirations during the course of the injection must be made. It is well to remember that the slightest movement may bring the inferior vena cava in contact with the needle and expose the vessel to the danger of secondary puncture.

If during the introduction of the needle the inferior vena cava has been injured, dark red blood will promptly appear in the barrel of the syringe. Should this occur the needle is immediately withdrawn and splanchnic anesthesia abandoned. One might, it is true, reinsert the needle into another place. Our experience, however, taught us that it is too dangerous to inject a large amount of novocaine solution into the retroperitoneal space under great pressure in the presence of a lateral puncture wound of the inferior vena cava, because an indirect intravenous injection might result. The puncture of the inferior vena cava *per se* is not of great importance, since no large hematoma is ever demonstrable during the course of operation.

The puncture of a small vein, such as one in the muscular origin of the diaphragm or in an atypically situated vena azygos or hemiazygos, is at once determined by the appearance of aspirated blood in the

syringe. The practical value of aspiration becomes apparent, although Braun maintains that it is not of much value. Even in those cases in which only a few drops of blood appear in the syringe we deem it advisable to remove the needle immediately and discontinue any further attempt at splanchnic anesthesia.

Toxic symptoms from resorption of the novocaine-adrenalin solution must be avoided. Braun and Haberer limit the injection to 100 c.c. of the solution. As a rule, we inject about 70 c.c. of the solution, but with large, strong individuals a little more may be used while in small and cachectic patients 50 c.c. will suffice. In these cases ½ or ¼ per cent of the novocaine solution is used, depending upon the general condition of the patient. In patients presenting marked anemia and a poor general condition ¼ per cent solution will produce an adequate anesthesia. If, some time after the injection is made, symptoms of intoxication appear (pallor, tachycardia, dyspnea) which are partly due to the adrenalin, it is best to lower the patient's head and administer an injection of caffeine.

By means of splanchnic anesthesia we may anesthetize the upper abdomen to such a degree as to permit resection for penetrating ulcer. The anesthesia lasts from one to one and a half hours, which is sufficient time in complicated cases to at least perform the resection of the penetrating lesion. If the effect of the anesthesia wears off so that the patient feels tension made upon the stomach, during the performance of the anastomosis, an additional injection of 10 c.c. is made close to the cardia. Percaine and pantocaine were proposed to lengthen the duration of the anesthesia. We did not make use of percaine as we have observed severe toxic symptoms following its use even in simple mesenterial anesthesia. Pantocaine is said to produce anesthesia lasting two to four hours, and according to the favorable reports of H. Schmid it seems to be superior to novocaine.

In our personal experience with splanchnic anesthesia we can say that it is without danger as long as intravenous injection is avoided. In 9992 cases of splanchnic anesthesia in abdominal surgery which were collected from the literature and also by personal communications from German surgeons, only 2 deaths could be traced; one was our own case and the other that of Maiditsch from the Haberer Clinic. In our case that ended fatally the cause of death can be ascribed to faulty dosage, the pantocaine solution being used for the first time, and 0.5 per cent solution was prepared instead of 0.05 per cent. During the course of the injection the patient became unconscious, developed clonic and tonic spasms, breathing stopped, and despite the use of artificial respiration, lobeline injection, etc., respiration could not be restored and the heart action ceased within a few minutes. At necropsy we found in this forty-eight years old man an inoperable carcinoma of the stomach which had already metastasized, and in addition careful search revealed a small lateral puncture in the vena azygos, this vessel being situated atypically in front of the twelfth thoracic vertebra. This puncture must have resulted from a repeated introduction of the needle, and since aspiration never returned blood in the syringe an intravenous injection is to be excluded. Overdosage by a ten-fold dose produced the fatal intoxication. It is possible that injuries of smaller veins do occur at times without being noted, and in spite of this, injections are made which produce only slight transitory toxic manifestations. The death, which fortunately occurred in this case of inoperable carcinoma, was certainly not due to the splanchnic anesthesia, for even simple mesenteric anesthesia would have ended fatally with so highly concentrated a solution of the pantocaine.

The fatality of Maiditsch (Haberer Clinic) occurred in a sixty years old woman with a severe myocarditis (pulse 112, extrasystoles), in whom a long time after the injection and during the course of a chole-

cystectomy there occurred respiratory and circulatory failure. Since the quantity and concentration of the anesthetic are not indicated we must assume that the ordinary quantity was injected, which amounts at the Haberer Clinic to 100 c.c. of ½ per cent solution. We may exclude an intravenous injection since death did not occur immediately but later in the course of the operation. Fatal novocaine intoxication as a result of resorption also seems quite improbable, since symptoms of clonic and tonic spasms, respiratory, and finally cardiac failure, which are the rule in absorption, were in this case lacking. It seems most probable, therefore, that death was due to heart failure (myocarditis). Nevertheless, the death in this instance cannot be dissociated from splanchnic anesthesia and hence must be ascribed to it.

In a personal communication v. Verebélyi states that he has noted one death in 242 cases of splanchnic anesthesia, which occurred half an hour after operation. Necropsy revealed a pulmonary embolus caused by a thrombus of the iliac vein and vena cava. Although the vena cava was not injured during the injection, Verebélyi believes that the thrombosis in the vena cava was occasioned by the splanchnic anesthesia. While we quote this case in this report, we do not ascribe the fatality to the splanchnic anesthesia, because we believe that the slight pressure on the vena cava produced by the palpating finger cannot possibly damage the intima to such a degree as to cause thrombosis. It is a rather plausible thought that the thrombosis in the iliac vein was present before the operation and had passed into the inferior vena cava, but not as high as the injection point or else the surgeon would surely have noticed it.

In view of the foregoing analysis, we find only 2 deaths in a total of 10,000 splanchnic anesthesias, one of which was caused by an error in preparation of a new solution. This yields a death rate of 2 in 10,000 cases. Again, if for comparison we resort to the method of Specht in calculating the danger of avertin narcosis compared with that of splanchnic anesthesia, our results show one death in 10,000 cases.

Splanchnic anesthesia has been performed in many patients with severe general diseases ("bad risk" cases) upon whom different operations were successfully performed, hence we may be permitted to disagree with Lundy (Mayo Clinic), who condemns splanchnic anesthesia as being a too dangerous and incomplete procedure. On the contrary, we maintain that splanchnic anesthesia is practically without danger provided two prerequisites are met; namely, avoidance of entering a vein, and exact gauging of concentration and amount of novocaine to be administered.

With general anesthesia death may not only result immediately but even on the third or fourth postoperative day; such occurrences are entirely unknown in splanchnic anesthesia.

Neither can we agree with Meeker's assertion, that splanchnic anesthesia is an inefficient method in abdominal surgery. His statement is based on 42 cases observed at the Mayo Clinic while our conclusions are drawn from a total of 1950 cases.

Naturally, one cannot examine the entire abdominal cavity nor remove an appendix adherent in the pelvis painlessly with only this form of anesthesia. It would, for this purpose be necessary to interrupt the rami communicantes from the sixth dorsal to at least the fifth lumbar nerve. We have never tried to perform an appendectomy or exploratory laparotomy with splanchnic anesthesia, but have successfully applied it in surgery of the upper abdomen; viz., in operations upon the stomach and the gall bladder. It has always been our practice to resort to general anesthesia if the patient complains of pain after novocaine injections. In spite of this, 92 per cent in over 1500 stomach resections could be operated upon by the use of splanchnic anesthesia alone. In the remaining 8 per cent general narcosis was used, either because the patient demanded it at the outset and it was discontinued as soon as splanchnic

anesthesia was performed, or because the operation lasted longer than the effect of the splanchnic anesthesia (e.g. radical operation of a peptic jejunal ulcer), an additional splanchnic injection being impossible. In only 2 per cent of the cases did the patients complain of actual pain, making general anesthesia necessary. These 2 per cent can truthfully be called failures in splanchnic anesthesia, as they are due to abundant formations of scar tissue in the retroperitoneal space, resulting from penetrating callous ulcers on the lesser curvature; or to the presence of large retroperitoneal glands, as observed in carcinoma of the stomach, thus preventing sufficient diffusion of the novocaine and thereby the left splanchnic nerve, for instance, is not anesthetized. To interrupt the left splanchnic nerve Pannett suggested injection of 10 c.c. of a 1 per cent novocaine solution to the left side of the aorta.

In operations on the biliary passages (cholecystectomy, choledochotomy, choledochoduodenostomy) splanchnic anesthesia renders excellent service. In these operations general anesthesia was employed in 10 per cent of the cases, mainly as induction narcosis because demanded by the patient.

For splenectomy splanchnic anesthesia is in the main insufficient, especially if the spleen is adherent to the diaphragm, because the peritoneum covering the lower surface of the diaphragm is not supplied by the splanchnic but by intercostal nerves. Splenectomy should, therefore, be performed with paravertebral injections augmented by a combination of local anesthesia of the abdominal wall, with mesenteric anesthesia and a short ether narcosis lasting long enough to accomplish separation of adhesions and delivery of the spleen. The operation is then concluded under local anesthesia.

For the other abdominal operations, particularly intestinal obstruction, splanchnic anesthesia is inefficient. Hence, we have never used it in these cases. This does not, however, justify the deduction that splanchnic anesthesia is useless in abdominal surgery. It is particularly indicated in cases complicated by severe affections of the heart and lungs, and in aged patients, when a combination of mesenteric anesthesia with short ether narcosis cannot be used. Since nitrous oxide is not always at our disposal, mesenterial anesthesia alone will not suffice in cases of penetrating ulcer or resection of carcinomatous stomachs.

By means of splanchnic anesthesia our results may be almost as good in aged individuals as those obtained in younger patients. In our material of 289 stomach resections for carcinoma in uncomplicated cases the mortality was 6.3 per cent, while in 116 patients between sixty and eighty-two years of age, it mounted to 10.3 per cent. In 1658 consecutive resections for ulcer of the stomach in elderly patients the results were even better. In this series 141 patients were between sixty and seventy-eight years of age, and despite this there were only 3 deaths. We firmly believe that it is imperative to avoid ether narcosis in patients advanced in years.

CONCLUSIONS

1. Splanchnic anesthesia will produce no injurious effects either during the course of injection or later if properly administered in the correct dosage, and if intravenous injection is avoided.

2. It will produce complete anesthesia in over 90 per cent of all surgical procedures in the upper abdomen.

3. It is especially indicated if mesenterial anesthesia alone is not sufficient, when nitrous oxide is not at our disposal, and when ether narcosis is contraindicated because of heart, lung and other complications, or because of the advanced age of the patient.

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PLEUROLYSIS

AN ADDITION TO THORACOPLASTY*

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ALMOST without exception all patients with pulmonary tuberculosis who come to thoracoplasty have had a preliminary attempt at, or trial of pneumothorax. This fact will be referred to again later in this article and unless so stated all thoracoplasties hereafter mentioned have been preceded by pneumothorax.

In pneumothorax, as in most other types of collapse therapy, the direction of the collapse is toward the mediastinum and the root of the lung. This is necessarily so, since normally the mediastinum and root of the lung are the only fixed points. When intrapleural negative pressure is relieved or positive pressure is applied, the lung collapses towards the fixed points, the mediastinum and root. The exception to the direction of collapse is seen in apicolysis where the collapse may be directed anteriorly or posteriorly. When pneumothorax fails to completely collapse pulmonary cavities, the most frequent cause of failure is the existence of adhesions between the parietal and visceral pleura. As the direction of the collapse is towards the one fixed point, the mediastinum, the adhesions are secondary or peripheral fixed points between which the lung and cavity is suspended.

In thoracoplasty the length of the ribs removed is not always the deciding factor in the complete collapse of pulmonary cavities. This is seen where extensive rib resection has been done and from a surgical viewpoint the thoracic cage is well collapsed, yet the pulmonary cavity remains uncollapsed; the opposite is likewise true where a limited resection was done and the thoracic cage was insufficiently collapsed yet the pulmonary cavity was completely collapsed.

The majority of pulmonary cavities which are not collapsed after satisfactory thoracoplasty are the ones in which extensive adhesions are present between the visceral and parietal pleura. These are the so-called suspended or hanging cavities, situated at the hub of adhesions which pull in opposite directions, and are in reality hanging between two or more fixed points. It is frequently observed that whenever the relationship between a cavity and its bronchus is altered so that the communication itself is shut off or the bronchus becomes stenosed or closed, the cavity becomes collapsed. This change in the cavity-bronchus relationship is observed clinically in a number of situations: (1) In the collapse of apical cavities following phrenic avulsion. These cavities are sufficiently removed so that the elevation of the diaphragm could not be interpreted as causing pressure on the walls of the cavities and could only be interpreted as causing change in the cavity bronchus relationship. (2) In the collapse of the cavities following intrapleural pneumolysis, a previous pneumothorax having been unsuccessful, even though the pressure recorded was high and the volume of air used was large enough to displace the mediastinum and collapse the entire lung with the exception of the cavity. The adhesion in this instance is suspending the lung and preventing any alteration in the relationship of the cavity and the bronchus. When the adhesion is severed a change occurs in

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this relationship and the cavity closes even though the volume of air used is less than that used before pneumolysis.

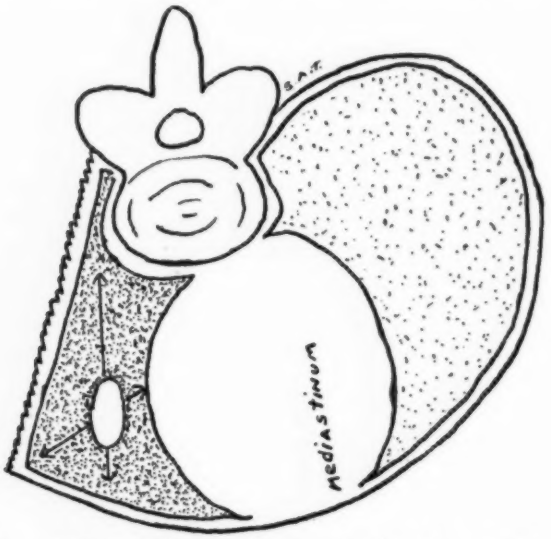

Fig. 1. Cross section of thorax, showing how a suspended cavity may be still uncollapsed after thoracoplasty in which complete bony collapse was accomplished. Arrows point to sites of adhesions. Adhesions are peripheral fixed points from which cavity is suspended and held open.

(3) In thoracoplasty where the rib resection is limited and the bony collapse is unsatisfactory. In all these situations the relaxation of a peripheral fixed point allows the cavity-bronchus relationship to become altered and as a result the cavity closes.

By internal pneumolysis, we release the peripheral fixed points and allow the collapse to continue towards the mediastinum. By thoracoplasty, in effect, we produce the same thing: the peripheral fixed points are relaxed and collapse continues towards the mediastinum. However where adhesions exist, thoracoplasty does not always sufficiently relax the peripheral fixed points, therefore additional extrapleural relaxation or pleurolysis is necessary.

The procedure which is here called pleurolysis is the stripping of the parietal pleura from its attachments to the chest wall and the endothoracic fascia. The term pleurolysis, as applied here, means a procedure which is done at the time of a thoracoplasty and becomes a part of the technique of extrapleural thoracoplasty.

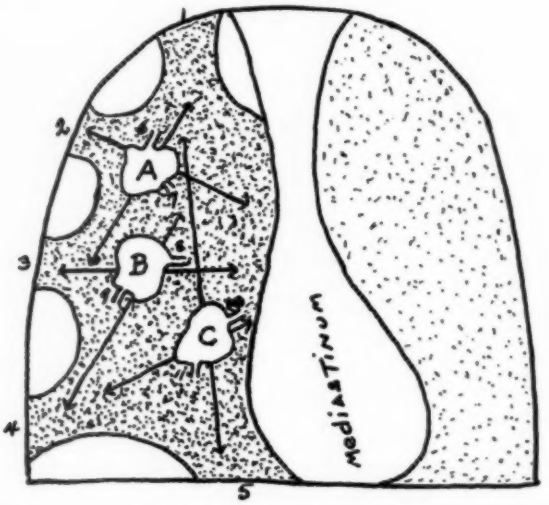

Fig. 2. 1–5, Adhesions of visceral to parietal pleura. 16–11, Communications between cavities A, B and C and corresponding bronchi. Diagram illustrates necessity of releasing all fixed points in producing a change in relationship between a cavity and its bronchus. When adhesions at 1 alone are released, cavity-bronchus communication at 6 is altered; however, should cavity-bronchus communication be at 7 instead of 6, relationship is unaltered until adhesion at 2 is released. Likewise with cavities B and C, respectively: if adhesions at 3 and 4 are released, communications at 8 and 10 are altered; however should communications be at 9 and 11, no change occurs in cavity-bronchus relationship until adhesions at 1 and 4 are released.

Pleurolysis, apicolysis and extrapleural pneumolysis are all similar in that the pleura is separated from the endothoracic fascia. Pleurolysis indicates that separation which is done at the time of a thoracoplasty, under direct vision, and extends over the apex and over the site of all pleural adhesions, no matter how extensive the area (Fig. 2). Pleurolysis naturally has no place in the operative procedure when adhesions do not exist between the parietal and visceral pleura, as the object of pleurolysis is to relax all peripheral fixed points.

Since the pleura is adherent medially to the mediastinum, this acts as a fixed point over its entire attachment. This attachment is not disturbed as the lung

collapses towards the mediastinum, the one remaining fixed point.

The dome of the parietal pleura, in addition to its attachment to the endothoracic fascia, receives supporting fibers from the scalenus anticus and medius muscles, from the ribs, vertebrae and costal cartilages. Also the fascia surrounding the large blood vessels in the neck, particularly the subclavian vessels and branches, gives fibers of attachment. Thus the dome of the pleura is actually suspended from above.

In extrapleural thoracoplasty, irrespective of the number and lengths of ribs removed, the dome of the parietal pleura remains suspended by the attachments just described. The sides of the pleural dome may be compresses, almost to the point of obliteration, yet the apex of the dome remains suspended high up and should the lung be attached to the pleura at this site, it also remains suspended high up (Fig. 3). A cavity in this part or just below this part of the lung will become a suspended or hanging cavity and it is this type of cavity that remains uncollapsed after the ordinary thoracoplasty. With simple resection of the anterior and posterior portion of the superior ribs, and even though the first three ribs are entirely removed, the apex is not obliterated but merely depressed.

Pleurolysis is done without opening the pleural cavity and is best accomplished in somewhat the manner of apicolysis. After one or two ribs have been removed and before the first rib is removed, a cleavage line is found at the site of the resection, between the parietal pleura and the chest wall. The pleura is gently stripped from its attachments over the dome in all directions. As the mediastinum is approached the stripping is stopped. The pleura may be very thin at times, and great care must be exercised to prevent a tear or perforation. For this stripping the glove finger is the best instrument, as gauze over the finger or on an instrument may cause perforation. The pleura at other times may be very thick and adherent and it will be necessary to actually desect it away from the chest wall.

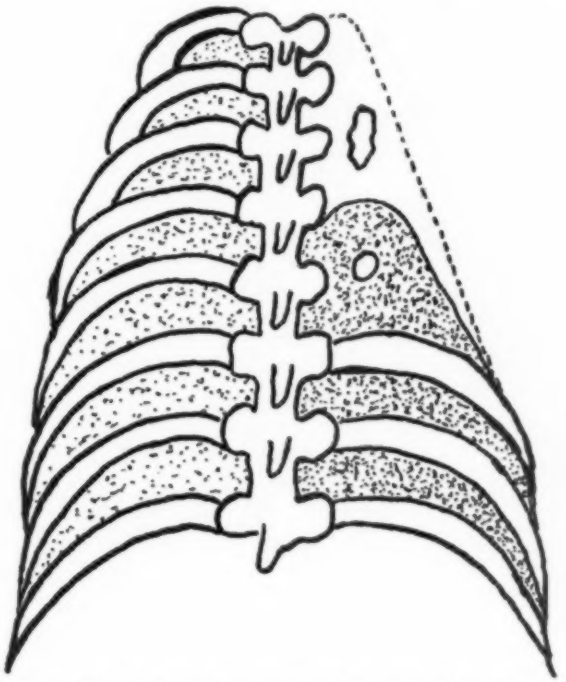

Fig. 3. Upper five ribs removed on one side. Dotted line represents site of parietal pleura after ribs have been removed and shows degree of lung collapse which is possible when adhesions exist at apex. Unbroken line represents dome of parietal pleura after pleurolysis and shows great increase in amount of lung collapse.

This pleurolysis should be continued down as far as the site of adhesions so as to completely release the lung and allow for a maximum collapse.

In apical pleurolysis it would seem that a forced expiration or cough might expand the lung and carry with it the pleura, back to the former site of attachment. This however does not occur as can actually be seen at the time of the operation, and subsequently observed by repeated *x*-ray examinations.

The pleura will again become attached to the endothoracic fascia, but in the meantime the lung is relaxed the peripheral adhesions released, and the attachments will be at a different level.

Where the adhesions are located entirely posteriorly and at the site of the resected ribs, that procedure in itself might have

the same effect as a pleurolysis in that the lung is somewhat released in that area. Many of the adhesions however, have lateral attachments beyond the area of rib resection and it is here that the lung is not released and the pulmonary cavity is still suspended and held open (Fig. 1). Even though a subsequent anterolateral rib resection be done, the lung may not be sufficiently released.

Pleurolysis is similar to closed pneumolysis in that the peripheral fixed points are released. The lung and cavity, being no longer suspended, is collapsed towards the mediastinum. Pleurolysis is recommended as a specific procedure in the collapse of the suspended cavities and in all thoracoplasties where adhesions exist between the visceral and parietal pleura.

SUMMARY

Extrapleural thoracoplasty is not always successful in completely collapsing pulmonary cavities, especially where adhesions exist between the visceral and parietal pleuras.

Pleurolysis by the separation of the peripheral fixed points allows a greater collapse of the lung to take place.

Pleurolysis causes a change in the cavity-bronchus relationship.

Pleurolysis is recommended as an addition to thoracoplasty, a specific procedure in the collapse of the suspended cavities.

Pleurolysis is recommended in all thoracoplasties where adhesions exist between the visceral and parietal pleuras.

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RHINOPLASTY

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SAN ANTONIO, TEX.

RHINOPLASTY is a method of plastic surgery that dates back to about 1600. It is probably the first maneuver of plastic surgery as we find it today.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

Numerous methods have been devised, all of which carry with them the main idea of switching a pedunculated flap into the nose region, and then by various procedures a nose is shaped out of the transplanted skin.

The method I am demonstrating shows the procedure in a complete nasal replacement, in a semi-replacement of the external nares, and in a replacement of the tip of the nose.

All patients lost the nasal tissue from cancerous ulcerations and the accompanying destruction following the use of destructive agents to cancer cells.

CASE 1. In August, 1929, a man of forty-eight years reported to me with the left half of his external nares gone.

Figure 1 shows the opening directly into the left internal nasal cavity, the columella and septum of the nose remaining in good condition.

Figure 2 shows an inverted keystone-shaped flap, which has been elevated and a similar shaped full thickness graft from the thigh stitched on to the back of this flap. The double pedunculated flap of the forehead. The full thickness graft was obtained from the medial aspect of the thigh.

FIG. 6.

FIG. 7.

The flap was allowed to remain in place ten days. This flap is very rich in blood supply because it carries with it the two angular arteries, which course lateral to the alae nasi to the forehead.

Figure 3 shows the condition about fourteen days after the double layered pedunculated flap had been made and four days after this flap was switched into the nasal defect. The defect on the forehead was covered with a full thickness graft, which was also obtained from the

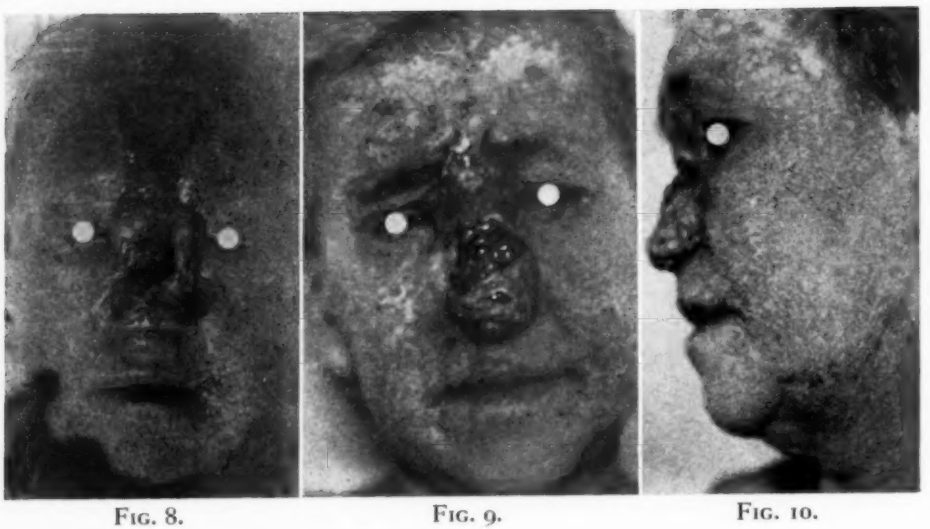

FIG. 8. FIG. 9. FIG. 10.

FIG. 11. FIG. 12. FIG. 13.

FIG. 14. FIG. 15. FIG. 16. FIG. 17.

medial aspect of the thigh. The flap was divided from its proximal attachment after it had been sewed into its new bed for three weeks. The division was made in three stages, at two-day intervals.

Figure 4 shows the nose finished, three months after the original step and six weeks after the last procedure.

Figure 5 was made twelve months after the final step was completed.

Case II. A woman, aged fifty-four, had been suffering with a lupus of the nose for about twenty years. She developed a malignant condition of the nose and it was deemed advisable to remove the nose and replace the diseased tissues.

Figure 6 shows the entire bridge and both alae of the nose involved in a basal-celled epithelioma. In addition to this she was suffering from a weeping eczema.

Figure 7 shows the nose removed by endotherm cautery with a flap raised on the forehead, the back lined with a full thickness graft obtained from below the breast. This method allows a freedom of choice of texture, color and consistency for the anterior skin surface of the new nose.

Figure 8 shows the new nasal tissue attached by its base and sewed into its place. This attached flap was allowed to remain in place three weeks. The full thickness graft which was used to attempt a closure of the forehead defect died and the wound finally epithelized and covered over.

Figure 9 shows the forehead wound entirely healed, the nasal defect closed and the nose functioning.

Figure 10 shows an ulcerated area of a returning basal-celled malignancy.

This patient later developed a secondary metastasis in the deep cervical gland and died.

Case III. A man, aged sixty-seven, had a basal-celled carcinoma of the tip of his nose. This growth had received large amounts of radiation from *x*-ray and radium over a period of about fifteen years. The growth at the time of operation had become very active and surgery seemed the best method of attack.

Figure 11 shows the original growth.

Figure 12 shows the keystone-shaped flap on the forehead lined with a full thickness graft from the thigh.

Figure 13 shows the flap hanging loose from the forehead.

Figure 14 shows the flap sewed into place after the diseased tip of the nose was removed.

In Figure 15 the flap is shown in place with a partial division of the pedicle. This was necessary owing to the fact that prolonged radiation had rendered the blood supply of the base of the flap very poor.

Figure 16 shows the entire flap divided with the upper end of the flap sewed into place on the bridge and side of the nose.

Figure 17 shows the finished result six months after the first stage of the procedure.

SUMMARY

A new method of rhinoplasty is described, illustrated by three cases.

This new method of rhinoplasty carries with it several important features:

1. It insures a healthy well-nourished flap with the two angular arteries.

2. The normal healthy tissue carries inhibiting factors to cancer growth.

3. There is no torsion or pulling on the flap or its pedicle.

4. It allows a minimum of deformity on the forehead.

5. It allows a selection of color, texture and consistency for the skin to be placed on the anterior surface of the new nose. The skin usually taken is from the anteromedial aspect of the thigh, where the skin is plentiful and without hair.

6. The full thickness graft lies in a very suitable bed for its growth to the pedicle of the forehead. In this position suitable pressure and counter pressure are easily secured by a marine sponge. There is no contracture of the graft or the pedicle because its shape is maintained when it is sutured into the defect on the forehead.

A MODIFIED TOREK OPERATION

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BROOKLYN, N. Y.

SOCIAL, sexual, physical and mental maldevelopment may result when testicles due to congenital defect fail to descend and assume their normal position in the scrotal sac.

It is generally agreed that early surgical procedure is indicated. If neglected, the cryptic testicle is prone to undergo atrophy, to become functionless and is also subject to other complications due to its abnormal location.

However, the existence of approximately forty different operations for orchiopexy suggests that no one is entirely satisfactory. The procedure most frequently employed is the Bevan operation, by which the testicle is exposed, liberated and brought down into the scrotum, and the inguinal canal finally closed as in herniorrhaphy.

One serious objection, however, has consistently been made in reference to the Bevan operation: After the spermatic cord has been adequately lengthened and the misplaced testicle correctly deposited at the bottom of the scrotal sac, the operation fails to provide sufficiently for continuous retention of the testicle in the scrotum over a long period of time. Too frequently both the scrotum and the testicle retract, giving an end-result anatomically incorrect and cosmetically displeasing.

The Torek operation was designed to overcome this fault. As an integral step the tunica albuginea testis was sutured to the fascia of the thigh to maintain continuous traction on the spermatic cord and a fixed position of the testicle. Such an attachment may become irritating

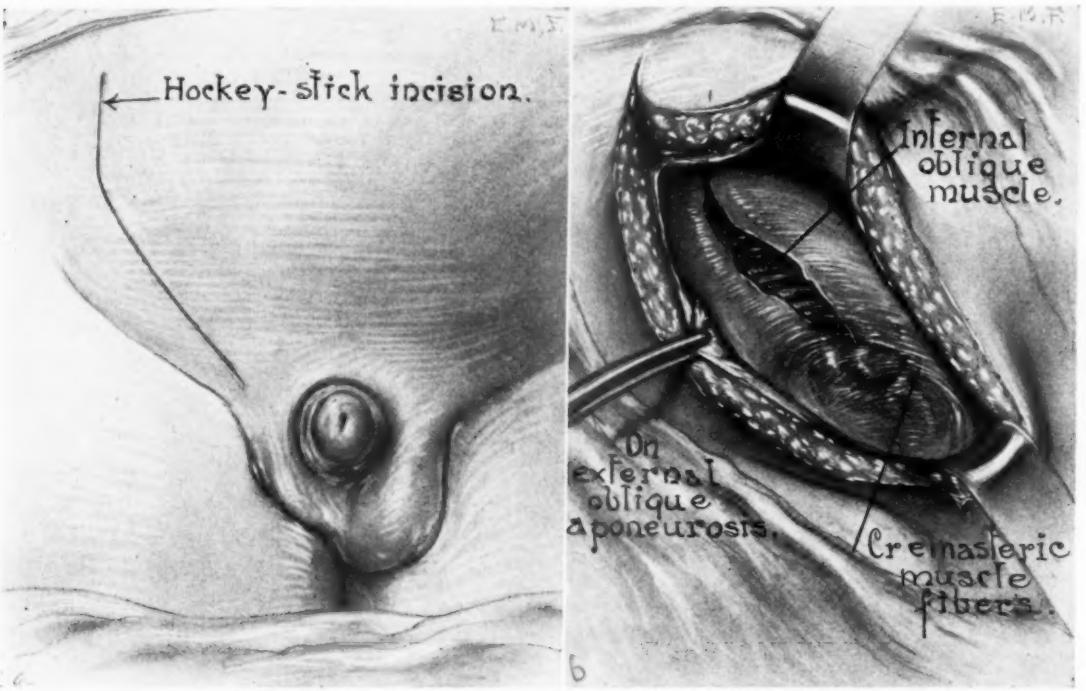

FIG. 1A. FIG. 1B.

FIG. 1. Hockey-stick incisions made through skin and aponeurosis of external oblique muscle.

and traumatic, and therefore, conducive to possible infection of the testicle, a complication of most serious consequence. Furthermore, the detachment phase of the operation (Torek) is rarely simple, involving further danger to the gland when the latter is removed from its bed in the thigh and intimate contact with the fascia.

We consider it unlikely and unimportant that a long imbedded testicle will be nourished and enriched by an additional blood supply which will be obtained from the thigh vessels, and which must penetrate the firm tunica albuginea testis.

To overcome these disadvantages, and thus provide greater postoperative comfort and a shorter period of disability from the operation, we have modified the technique as follows:

Over the inguinal canal, hockey-stick shaped incisions, beginning at the pubic area, are made through the skin and the aponeurosis of the external oblique muscle. The broken lines are directed outward and upward (Fig. 1).

The external abdominal ring, which usually is wide and located high in cryptorchidism, is split through at the middle of the intercolumnar fibers. The blades of the aponeurosis are separated widely to permit more mobility; and better relaxation of the arched fibers of the internal oblique and transversalis muscle (Fig. 2).

The gubernaculum testis should be identified and traced to the lower attachment, which is then doubly clamped low down, cut and tied at both ends (Fig. 3).

Now the testicle is palpated, viewed, appraised and its relationship studied. Usually it is covered with a veil of cremasteric muscle, from which it must be lifted. Here a few bleeding vessels must be controlled by ligatures. (Fig. 4.)

The testicle and the spermatic cord are now gradually withdrawn from the inguinal canal. An *en bloc* finger dissection will mobilize this structure from its bindings of cremasteric muscle, adhesions and transversalis fascia. This is best performed by starting posteriorly and working deeply and high up into the retroperitoneal space (Fig. 5).

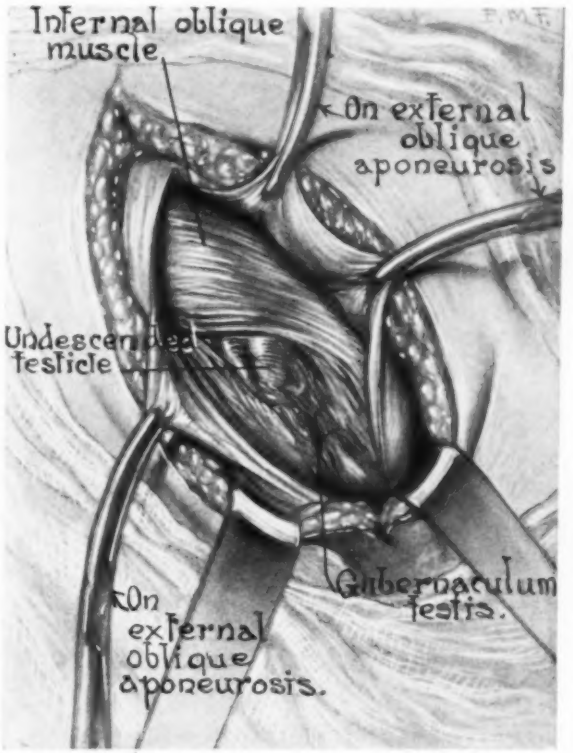

Fig. 2. Blades of aponeurosis are held widely apart. Maldescended testis viewed at internal ring of inguinal canal. It is usually veiled by cremasteric muscle fibers.

Anteriorly and laterally, a similar performance liberates the spermatic cord and the vaginal process from the anterior and lateral parietes. Care must here be exercised to avoid breaking into the general peritoneal cavity.

The vaginal process or peritoneal tube is now freed from the vas deferens and spermatic vessels of the cord. The cord may be lengthened by separating all peritoneal remnants and adventitious tissue between the vas deferens and the spermatic vessels as far down as the testicle and epididymis.

If additional length is required, a complete and high dissection of the posterior parietal peritoneum from the spermatic vessels up to the renal area will accomplish the purpose (Fig. 6). This must be done carefully, avoiding any hard pull on the spermatic cord, as the veins are easily torn by forcible traction.

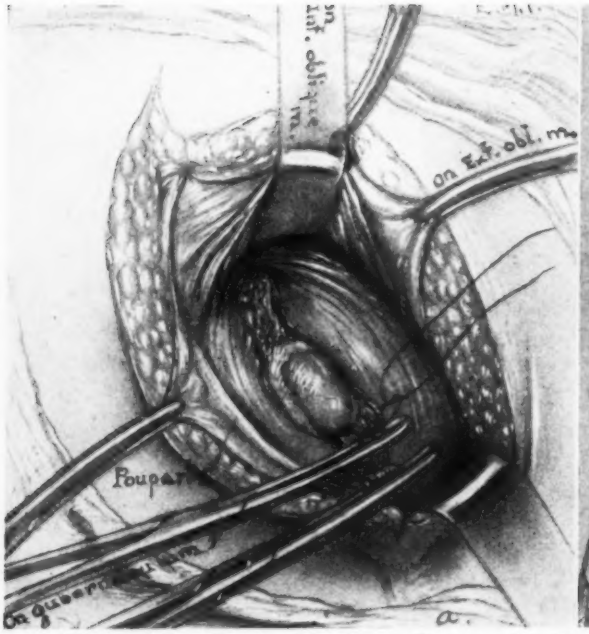

FIG. 3. Gubernaculum testis doubly clamped, cut and ends ligated.

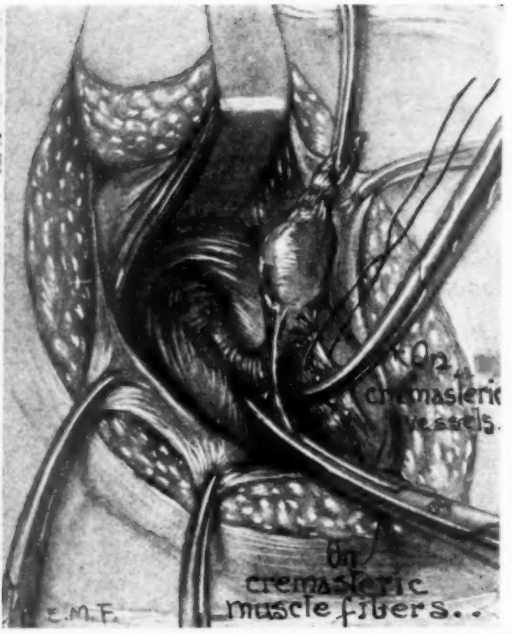

FIG. 4. Ligating cremasteric vessels as testicle is lifted.

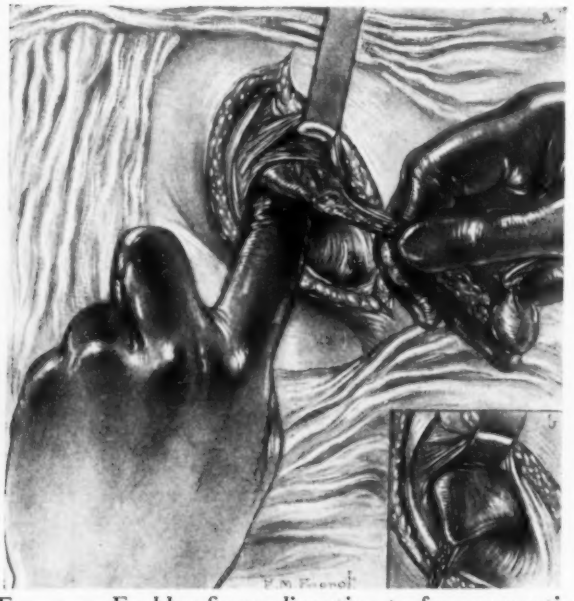

FIG. 5. A. En bloc finger dissection to free spermatic cord and processus vaginalis from its bindings of cremasteric muscle, transversalis fascia and adhesions. B. Small peritoneal sac (processus vaginalis) to be raised from vas and vessels.

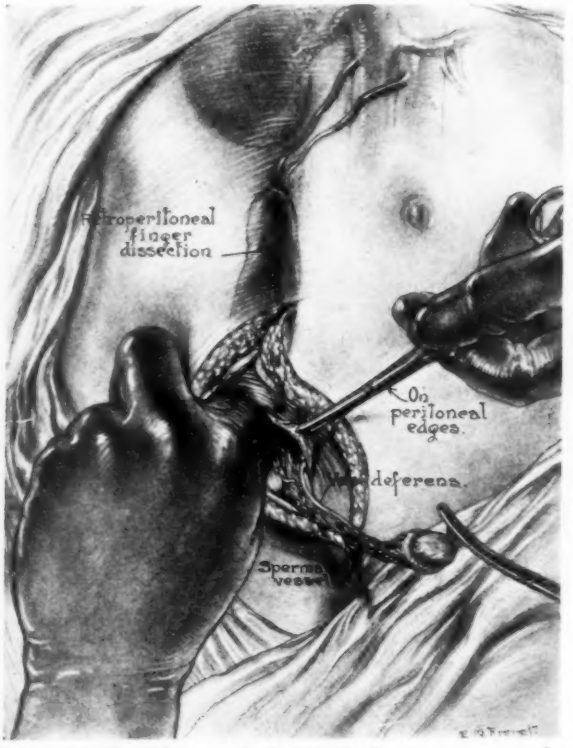

FIG. 6. Fore-finger insinuated between posterior parietal peritoneum and spermatic vessels up to renal area.

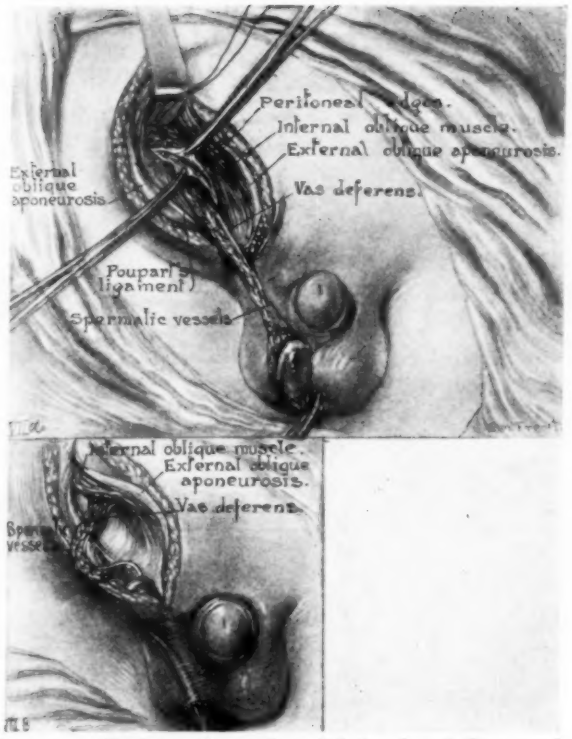

FIG. 7. A. Peritoneal opening tightly closed. Spermatic cord and testicle aligned and measured for proper position and length. B. Testicle pulled to bottom of scrotal compartment.

FIG. 8. Interrupted sutures unite posterior skin edges of scrotal and thigh incisions.

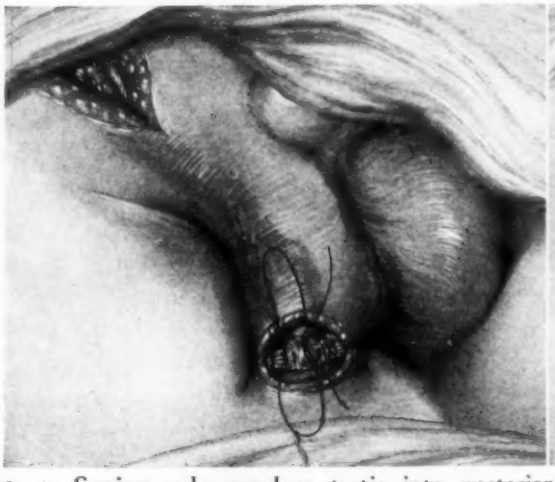

FIG. 9. Sewing gubernaculum testis into posterior union of skin edges.

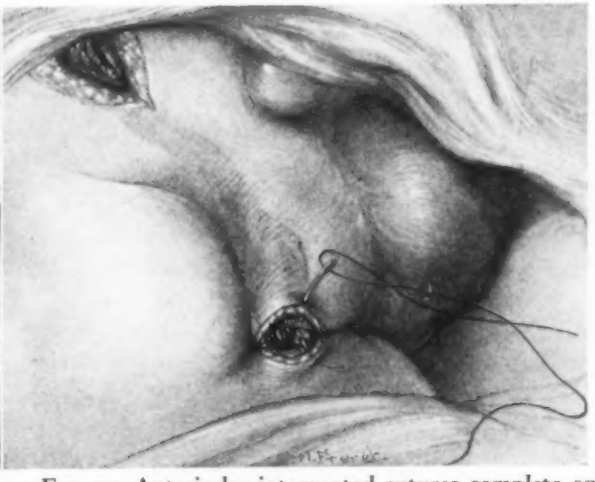

FIG. 10. Anteriorly, interrupted sutures complete and close anastomosis of skin flaps. An occasional stitch is taken through gubernaculum.

The new bed for the testicle is prepared by forcing a finger to the bottom of the scrotum. We have omitted the gauze

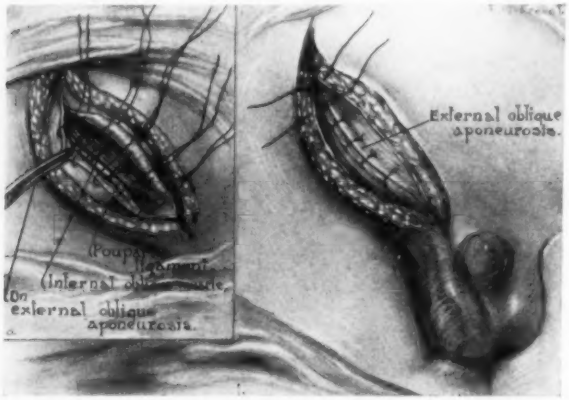

FIG. 11. Inguinal canal reformed. Spermatic cord not displaced. Single interrupted sutures unite arched fibers and conjoined tendon of transversalis and internal oblique muscles to Poupart's ligament. Cut edges of external oblique fascia reunited.

pack generally employed for this purpose, because it causes trauma and is unnecessary.

The base of the scrotum is next grasped with two Allis forceps 2 cm. apart. A transverse slit is made through the skin and dartos between the clamps. Another incision, equal in length, parallel, but lower, is made on the inner and upper part of the thigh, facing the scrotum.

The cord structures are correctly aligned. The length is measured and the position of the testicle in the scrotum is noted (Fig. 7A). If satisfactory, a clamp is passed through the scrotal incision to grasp and withdraw the free end of the gubernaculum testis through the scrotal slit (Fig. 7B). The testicle is carried to the bottom of the scrotum.

A union of the upper skin flap in the thigh to the posterior skin flap of the scrotum is then established with interrupted sutures (Fig. 8).

Now the gubernaculum is stitched to the newly formed posterior skin suture line with interrupted fine silk sutures (Fig. 9). The anterior and complete closure of the skin wound is then effected with silk sutures, which also incorporate the gubernaculum to this union (Fig. 10).

In our early cases, we occasionally placed the thigh incision too low, thereby overstretching the scrotal and thigh skin. As a result, proper and primary coaptation was not obtained due to marginal tension and gangrene with partial or complete separation at the line of union.

Attention is now redirected to the inguinal area. The inguinal canal and structure are reformed and reunited with No. 1 catgut sutures. The spermatic cord should not be displaced (Fig. 11).

Two weeks after the orchiopexy the patient is encouraged to resume his physical activities. Two months later, the scrotum is easily detached from the thigh, a step quickly performed by incision around the circumference of the scar and through the gubernaculum. A few interrupted sutures close the wounds of the two surfaces.

Recently Hepler advocated sewing the gubernaculum to the fascia of the thigh. He, too, felt that sutures to the testicle may cause serious damage to that organ.

Our experience has been that fixing the gubernaculum to the newly formed skin anastomosis of the scrotum and thigh gives less discomfort and disability and provides secure anchorage without rigidity, thereby eliminating the objectionable features that follow the Torek type of orchiopexy. Efficient traction and countertraction are continuously maintained through the medium of a supple, flexible, and yielding skin graft.

This operation has been performed with satisfactory results in 45 cases of maldescended testicle.

HYPERTROPHIC PYLORIC STENOSIS IN THE ADULT

DISCUSSION AND CASE REPORT

RAYMOND F. ELMER, M.D., AND CHARLES E. BOYLAN, M.D.

CHICAGO

DURING the past five years, with the assistance of improved roentgenographic methods, a renewed interest has been noted in a condition which has been dormant as a clinical entity for many years. Scattered and incomplete reports have appeared in the medical literature over a period of a century. Notwithstanding this, hypertrophic pyloric stenosis in the adult has not had serious clinical consideration until recently.

A few men have reported the occurrence of benign pyloric stenosis appearing in middle life and have likened it to the type of obstruction seen only in infants. Various theories have been advanced concerning a possible etiology and will be discussed later in the paper.

We wish to indicate that this condition occurs not uncommonly and is frequently misdiagnosed, partly because the condition is very difficult of recognition, and partly because the possibility of its occurrence is not given proper consideration. Our purpose is not the presentation of a rare and unknown entity, but rather a dissertation on the subject from a standpoint of etiology and diagnosis. Possibly it may serve to throw some light on the cause of many dramatic cures of so-called scirrhous carcinoma of the pylorus.

HISTORICAL REVIEW

A review of the literature reveals the fact that this entity is no recent discovery. As early as 1835 Cruvielhier recognized this condition. He reported the occurrence of benign hypertrophic pyloric stenosis in a woman of advanced years who had died from frequent vomiting. The diagnosis was confirmed at autopsy. In 1885, Maier after studying a series of 31 cases, which subsequently came to autopsy, described the pathologic findings and believed the condition to be of congenital origin.

In 1902, Meinel observed a case which came to operation, and a section of the pylorus was examined histologically; he states: "Whether the hypertrophy of the musculature is to be considered as due to congenital changes cannot be stated with certainty. The lack of inflammatory changes in the mucosa of this part of the stomach would suggest such a congenital nature." Meinel is of the opinion that carcinomatous new growths might easily develop from this type of stenosis.

In 1917, Urrutia described the occurrence of this condition in a woman forty-three years of age. The patient complained of gastric symptoms and a diagnosis of pyloric neoplasm was made. Subsequent operation revealed a hard contracted pylorus. There were no histologic alterations in the mucosa, nor any evidence of malignant degeneration.

In 1926 Bianchetti encountered this condition in a woman sixty-one years of age. A preoperative diagnosis of stenosing carcinoma of the pylorus had been made. Operation and subsequent tissue examination revealed a concentric hypertrophy of the smooth muscle of the pylorus with an almost complete stenosis of the pyloric orifice. He named the condition "stenosing hypertrophy of the idiopathic type."

In 1931 Chomet writing of this condition stated: "In this type of lesion, there is a stenosis of unknown origin. Spasm plays a large part in the symptomatology, and during the late stages radiographic signs indicate a confirmed stenosis."

Coleman in 1932 reported the case of a man thirty-eight years of age, who gave a suggestive ulcer history and was eventually operated on because of symptoms of obstruction. Microscopic examination of the specimen revealed a benign hypertrophic pyloric stenosis. He is of the opinion that congenital hypertrophic pyloric stenosis of infants may persist in varying degrees throughout life and manifest symptoms at a late date.

McNamee has contributed some enlightening histologic and pathologic details on the subject.

Kirklin and Harris of the Mayo Clinic have recently studied a series of 81 cases and arrived at some valuable conclusions which will be referred to later in the discussion.

CASE REPORT

H. G., aged sixty-eight, male, presented himself for examination and gave the following history: For the past five weeks, he had noticed epigastric pain and a sensation of distention associated with much belching. The abdominal pain was described as being of a dull aching character; usually appeared shortly after the ingestion of food and was relieved by vomiting only. Antispasmodics apparently had no alleviating effect. Solid foods caused greater discomfort than liquids. Anorexia and nausea were common and weight loss became progressive, amounting to 15 lb. in five weeks.

Prior to the onset of these recent symptoms the patient had enjoyed good health and had never, as far as he could recall, had any difficulty referable to the gastrointestinal tract.

A plate and fluoroscopic examination of the stomach was made and the following findings elicited (see Fig. 1):

The stomach filled rapidly and showed a spastic condition of the distal portion of the antrum, which remained constantly irregular for the first hour. Peristalsis did not pass through this portion. An occasional fleck was seen in the extreme portion of the antrum but was no constant. Rugous folds were not seen at first, but after repeated examination they were visualized in the antrum. (Fig. 2.) Hence it was believed no malignant degeneration of the mucosa was present. On palpation, no evidence of a tumor was felt. Furthermore, the stomach showed evidence of distensibility and was not adherent. Definite retention of food from the previous night was noted. At the end of the first examination, the evidence pointed to a hypertrophic pyloric stenosis of the adult type. The pyloric muscle itself was thickened and lay in a concentric position.

Re-examination of the stomach the following day showed occasional vigorous peristalsis passing through the entire antrum. The pylorus, however, remained elongated and was concentric in position. The findings again indicated pyloric stenosis of a spastic hypertrophic type.

The evidence at hand did not warrant a diagnosis of ulcer or cancer in this case, although these two conditions are the ones that readily simulate the adult type of hypertrophic pyloric stenosis.

A blood Wassermann test was taken and repeated, with a negative result.

Surgical intervention was then advocated with the idea of relieving the pyloric obstruction in whatever manner seemed best adapted.

Operation: A spinal anesthetic consisting of 200 mg. of novocaine was administered, and the abdomen opened. The stomach was moderately dilated, moderately thickened, but uniformly smooth. A hard, rounded elevation about the size of a large olive was noted in the pyloric region. To the examining finger, the tumor resembled a hard annular constriction which could not be dilated. There was almost a complete occlusion of the pyloric orifice, but no glandular enlargements could be noted. The gall bladder and appendix were normal.

Since it was impossible by palpation to determine the exact nature of the tumor, a frozen section was rapidly made. This revealed no evidence of neoplasm.

Because of the gross and microscopic appearance, it was judged that this was a case of benign adult hypertrophic pyloric stenosis.

In order to obtain the section for examination, the pyloric ring had been incised transversely including the mucosa. The rent in the mucosa was sutured, and the incision in the pyloric musculature closed horizontally, thus constituting a modification of Ramstedt's technique. A posterior gastrojejunostomy was then performed and the abdomen closed.

The patient made an uneventful recovery and was discharged from the hospital on the

twelfth day. Six months has elapsed since the time of operation. He has gained 15 lb. in weight, and is able to eat whatever type of food he desires with no discomfort whatsoever.

Fig. 1. Note constant narrowing of extreme portion of antrum, due to hypertrophy of pyloric muscle. This constriction is constant, and is not due to temporary spasm. Note also impressions on base of duodenal cap caused by hypertrophied muscle. These findings may easily lead to a false diagnosis of malignancy.

Fig. 2. Exposure with fluoroscopic unit. Note rugous folds of antrum in region of constriction. Mucous membrane is intact, hence carcinoma is ruled out.

Pathology: A detailed microscopic study of the specimen revealed the following findings:

There was a marked hypertrophy of the circular muscle fibers, which ended abruptly at the beginning of the duodenum. The interstitial tissue between bundles of muscle fibers was greatly increased and consisted largely of fibrous tissue and scattered endothelial cells. In the mucosa, the characteristic changes of gastritis were noted. Lymphatic tissue and inflammatory cells were present in the submusosa, but nowhere was there any evidence of malignancy.

ETIOLOGY

Very little is known concerning the etiology of hypertrophic pyloric stenosis in the adult. The following origins have been advanced by the more prominent authors: (1) *congenital;* (2) *spastic;* (3) *endocrine* (hyperadrenalism).

From the literature on the subject, the consensus of opinion seems to point to a congenital origin. It is believed that infantile congenital hypertrophy may persist throughout life. It is possible that these individuals may go through life with little or no discomfort until some complicating change occurs which renders surgical aid necessary.

The first symptoms which occur are primarily due to a gastritis and require about ten days to develop in an infant, whereas in the adult, a latent period of many years may intervene, and then, possibly aggravated by some associated intra-abdominal infection, gastritis occurs, and gastrointestinal symptoms are complained of.

Bianchetti believes some of these cases may be on a neurogenic basis.

Pylorospasm, according to the theory of Carle, Doylan and Kussmaul, may be accompanied by functional hypertrophy of the sphincter with no lesion to pyloric mucosa.

A long-standing irritation is believed to be insufficient for the production of this condition. According to Landerer and Maier, the pyloric stenosis conditioned by a pure hypertrophy of the musculature must lead to a constriction of the gastric outlet. Such a constriction is believed by the afore-mentioned authors to be due to a congenital stenosis of the pylorus. A chronic irritation of the gastric mucosa is usually found in association with these constrictions.

Kaufmann in addition to the congenital theory suggests "a tumor-like hyperplasia of muscle" and "the effect of spasm" as etiologic factors.

Other authors have mentioned an endocrine dyscrasia, principally a hyperadrenalism, as possible causative factors.

It is a well-known fact that intra-abdominal pathology such as cholecystitis, appendicitis, peptic ulcer, etc. is often associated with pylorospasm. In this connection, Kirklin and Harris of the Mayo Clinic studied a series of 81 cases and report as follows:

> In 50 cases the hypertrophy was associated with other disease as follows: Ten cases with duodenal ulcer, 4 with duodenal ulcer and duodenitis, 2 with duodenal ulcer and chronic cholecystitis with gallstones, 5 with duodenitis only, 12 with gastric ulcer, one with both gastric and duodenal ulcer, one with gastric carcinoma, 7 with chronic cholecystitis and cholelithiasis, 3 with chronic cholecystitis only, and 5 with subacute or chronic appendicitis.

It is assumed that the associated lesion preceded the hypertrophy, hence the hypothesis that pyloric hypertrophy commonly results from reflex pylorospasm, would have additional support.

DIAGNOSIS

Because of its clinical similarity to other gastric conditions, the diagnosis of adult hypertrophic pyloric stenosis is difficult to determine. It is not commonly made before operation although it is possible for the roentgenologist to indicate this condition if a careful examination is made and the possibilities are borne in mind.

ROENTGENOGRAPHIC FINDINGS

Radiography usually reveals a pyloric obstruction with gastric retention. This entity presents characteristic findings which according to McNamee are as follows: (a) concentric and elongated pyloric canal; (b) widening of the pyloric sulcus (space between the stomach and duodenum); (c) constant unchanged appearance of the pylorus, which is not affected by manipulation or medication. The most characteristic finding is the concentric and elongated pyloric canal.

The normal pyloric canal does not exceed 0.8 to 1 cm. in length. In the presence of pyloric muscle hypertrophy there is an increase from 2 to 3 cm.

An infolding of the mucosa of the canal is often noted and this depression must be differentiated from ulcer. It will not, however, retain barium when manipulated.

The presence of unchanged rugous folds extending from the stomach into the duodenum rule out ulceration of the mucosa either from carcinoma or gastric ulcer.

Kirklin and Harris state: "The most obvious direct roentgenographic manifestation of uncomplicated pyloric hypertrophy is elongation of the pyloris ring." Recently a crescentic induration of the bulbar base has been noted, and was present in all of a series of cases in which the bulbar base was plainly depicted. It accords with the morbid anatomy of hypertrophic pyloric stenosis and has not been observed in other states either of health or disease. They believe that this sign in conjunction with prepyloric narrowing may prove to be pathognomonic.

MORBID ANATOMY

The pylorus becomes a tube measuring from 2 to 3 cm. in length, twice the diameter of a lead pencil, straight or slightly bent, with the curvature directed towards the bulb, of a hard consistency and projects into the duodenum. The hypertrophy is due to an increase in mass of the individual muscle fibers. There is a longitudinal infolding of the mucous membrane which contributes secondarily to narrowing the lumen.

DIFFERENTIAL DIAGNOSIS

This includes (1) all forms of ulcer (healed and active); (2) pyloric carcinoma; (3) pylorospasm; (4) lues, all of which may be differentiated after a fashion by clinical and roentgenographic methods, but the final word cannot be said in any of these cases without laparotomy.

TREATMENT

Treatment is entirely surgical. Whatever procedure employed must be determined by the extent of hypertrophy and the judgment of the operator.

A Ramstedt procedure will give good results but it is the belief of the writer that gastrojejunostomy or a combination of both will be most satisfactory.

CONCLUSION

1. Benign hypertrophic pyloric stenosis in adults occurs frequently enough to warrant its consideration clinically.

2. At the present time the weight of evidence seems to indicate a congenital basis although reflex spasm has not been ruled out as an etiologic factor.

3. In the case reported neither clinical nor operative evidence of co-existing intra-abdominal pathology could be demonstrated.

4. The roentgenologic findings of most assistance are, concentric and elongated pyloric canal, constant and unchanging position of the pyloric antrum, and widening of the pyloric sulcus. The presence of unchanged rugous folds extending from the stomach into the duodenum rule out ulceration of the mucosa.

5. In individuals in the so-called cancer age, the definite diagnosis of this condition preoperatively will preclude the necessity of serious and extensive resections, especially since these patients are poor surgical risks. Moreover a more gratifying prognosis may be given.

6. Because of the nature of this condition and its clinical similarity to many other gastric conditions, the surgeon must necessarily depend on laboratory assistance, and, since our greatest diagnostic aid is the *x*-ray, the roentgenologist should be encouraged to perfect a technique for this condition, in order to effect a more positive diagnosis after film examination.

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CYTOLOGIC RESPONSE TO PERITONEAL IRRITATION IN MAN

A PROTECTIVE MECHANISM

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MUCH work has been reported on the cytology of the peritoneal fluid of animals. To summarize this: It is evident that the normal peritoneal fluid of laboratory animals contains very few neutrophils. The total cell count varies with the species, and the injection of foreign material into the peritoneal cavity causes cellular changes in the fluid. These are characterized by early increase in the number of neutrophils, to a maximum in six to twenty-four hours, followed by diminution of the number of neutrophils and increase in the number of mononuclear forms to a maximum about the third day. Experimental animals can be protected against peritonitis by intraperitoneal injection of foreign material, either inert substances or vaccines.

Much work also has been done on the cytology of serous exudates and transudates of man, particularly with reference to the recognition of malignant cells in the fluid, but very little investigation has been made of the cytology of peritoneal fluid of man in cases other than ascites.

We have perused the considerable literature of these subjects but only a few articles can be referred to at this point. A few authors are mentioned also in the comment, toward the end of the paper.[1,3,5,6,7,14]

The question frequently has arisen as to what takes place in the peritoneal cavity of man when inflammation of the intra-abdominal organs is present and when vaccines are injected intraperitoneally. Presumably the same reactions take place as in experimental animals. The normal cell count of peritoneal fluid has not been known, and only in extreme infections or ascites has the cytologic picture of peritoneal fluid been determined. The greatest obstacle always has been the obtaining of sufficient fluid to study and the procuring of this from persons whose peritoneal cavities are normal. An attempt is made here to answer these questions in part and to describe a method whereby fluid can be obtained from almost any patient at laparotomy.

A piece of heavy glass tubing 10 inches (25 cm.) long, of small bore, is treated so that the hole at one end is turned a little to one side and the end made smooth and dull; the other end is shaped to fit a small rubber bulb. The apparatus is easily sterilized and dried. At operation, the patient's abdomen is opened down to the peritoneum and hemostasis carefully obtained. A small hole is then made in the peritoneum, the end of the glass tube is passed down between the loops of bowel to a point low in the peritoneal cavity, and the bulb is allowed to exert suction for a moment. Generally a few drops of fluid will be drawn into the tube, which is then handed to an attendant in the room. The fluid is blown out on a slide, a count is made of the leucocytes, in the usual manner, and the remainder of the fluid is drawn out as for a blood smear. The smear is later stained with Wright's stain and a differential count is made. Fluid is obtained with more difficulty from fat than from thin people, and more erythrocytes are noted in the fluid from women than in that from men. The procedure requires only a few seconds.

Fluid obtained from human beings by this method contains cells corresponding

exactly with those found in the peritoneal fluid of experimental animals. Erythrocytes, lymphocytes, neutrophils, eosinophils and basophils, morphologically the same as those in the blood stream, are encountered. In addition to these cells, another type of cell is found; it is similar to the blood monocyte, but frequently has a more foamy cytoplasm and a more or less lobulated nucleus, sometimes even two nuclei. These cells are morphologically identical with the reticulo-endothelial cells of the blood found in cases of subacute bacterial endocarditis. These cells will be referred to here as histiocytes (Fig. 1). Desquamated pavement cells occasionally are seen, but by the method described not enough are obtained in the fluid to alter the total counts. Total counts of the erythrocytes were not attempted in the study here reported.

Table 1
PATIENTS NOT VACCINATED

Case	Lesion	Operation	Leucocytes in Peritoneal Fluid						Clinical Course
			Per Cubic Millimeter	Differential Count, Per Cent					
				Histiocytes	Lymphocytes	Polymorphonuclears	Eosinophils	Basophils	
I	Carcinoma of rectum, low	Colostomy	2,250	30	66	4	..	..	Good
II	Duodenal polyp	Exploration of duodenum	2,662	56	27	2	14	1	Good
III	Carcinoma of rectum, low	Colostomy	1,900	49	36	..	6	9	Good
IV	Fibromyoma of uterus, small	Hysterectomy	650	..	82	16	2	..	Good
V	Gastric ulcer	Gastro-enterostomy	1,083	41	45	4	..		Good
VI	Fibromyoma	Hysterectomy	1,750	70	25	5	..	..	Good
VII	Chronic cholecystitis	Cholecystectomy	4,550	59	37	1	1	2	Good
VIII	Carcinoma of rectosigmoid	Colostomy	5,400	46	14	40	..	..	Good
IX	Carcinoma of rectum, low	Colostomy	6,190	44	28	28	..	..	Good
X	Fibromyomas, tarry cysts	Hysterectomy	8,750	49	48	3	..	..	Good
XI	Chronic appendicitis	Appendectomy	14,375	45	7	46	2	..	Good

Average total leucocyte count 4505 per cubic millimeter.

Fluid was obtained from a number of patients at operation, some had been vaccinated intraperitoneally; others had not been so vaccinated.

In Cases I, II and III (Table 1) the peritoneal cavity was considered to be normal. Two of the patients had carcinomas of the lower part of the rectum and the abdomen was opened preparatory to

inguinal colostomy. At operation the cavity was found to be negative for any demonstrable pathologic lesion. The third case was one of duodenal polyp. At operation this lesion was found to be very small and intra-intestinal. The total cell counts were 1900, 2250 and 2662 per cubic millimeter of fluid, respectively. The differential counts are shown in Table I; the low percentage of neutrophils is noteworthy. The number of cases (3) was small, but it is believed that a larger series would give approximately the same average, at least between 1000 and 3000 cells per cubic millimeter of fluid. The differential count was entirely in accord with that obtained from the fluid of normal animals. Forms intermediate between lymphocytes and histiocytes were seen.

Samples of peritoneal fluid were obtained from 8 other patients with intra-abdominal lesions accompanied by various degrees of inflammation (Cases IV to XI inclusive). In Case IV the total cell count was low and the differential count rather unexpected. As is frequently the case with uterine myomas, the amount of free fluid in the abdominal cavity was considerably increased; the dilution may have accounted for the low total cell count, but the lack of histiocytes remains unexplained. A slight increase in the number of neutrophils probably resulted from some mild irritation by the tumor. In Cases V and VI the pictures were similar to that in the cases in which the peritoneal cavities were normal in spite of some pathologic lesions. In Case VII there was a slightly elevated total cell count but practically no neutrophils were found. This was a case of cholecystitis of long standing and the disease was reflected in the fluid by the fact that the total cell count was raised, while the number of neutrophils was low. In Case VIII there was a carcinoma of the rectosigmoid, with some reaction about it. As would be expected in intra-abdominal inflammation, the total count was increased and the percentage of neutrophils was raised. In Case IX there was a carcinoma low in the rectum; the case might be compared with two of the cases in which the peritoneal cavity was considered to be normal. However, the patient was in poor condition and could in no way be considered normal. The total cell count and the percentage of neutrophils were both increased. In Case X there was considerable old inflammation about bilateral tarry cysts of the ovaries. The total cell count was high, but the percentage of neutrophils was low. Case XI was that of a young girl who was operated on for chronic appendicitis. The appendix appeared benign but the total cell count was rather high and the percentage of neutrophils was increased. It was felt that the appendix would not have caused such a reaction. Considerable blood was noted in the fluid, a not uncommon finding in women, but menstruation was occurring at the time. There may have been slight reflux of blood through the oviducts, bringing some mild infection into the peritoneal cavity; the ruptured follicle may have caused the reaction, or there may have been another undiscovered pathologic lesion. The average total cell count for these 11 cases was approximately 4500 per cubic millimeter of fluid. Clinically, all the patients made good recoveries.

Peritoneal fluid was obtained in the same way from patients who had been vaccinated intraperitoneally. The interval between vaccination and operation ranged from twenty-four to 144 hours, in the majority of cases the interval was seventy-two hours. Thus far, intraperitoneal vaccination has been carried out only in cases in which operation on the large intestine was anticipated. Consequently this series is composed chiefly of cases in which there were malignant lesions of the colon.

Table II contains a summary of data obtained in cases in which vaccine was given, grouped according to the interval of time between vaccination and operation. In Case XII vaccine was given only twenty-four hours before operation. As is characteristic after that interval in experimental animals with mildly irritated peritoneums,

so with these patients the total cell count was greatly increased and the percentage of neutrophils was high. In Case XIII the total count was moderately increased after as is usual and the postoperative recovery was retarded. In Case XIV the total count for the same interval was lower, but the percentage of histiocytes was very high.

TABLE II
PATIENTS VACCINATED

Case	Lesion	Operation		Leucocytes in Peritoneal Fluid						Postoperative Course
					Differential Count, Per Cent					
		Type	Hours after Vaccination	Per c.mm.	Histiocytes	Lymphocytes	Polymorphonuclears	Eosinophils	Basophils	
XII	Inoperable carcinoma of hepatic flexure	Ileocolostomy	24	81,800	7.5	2.5	89	0.5	0.5	Uneventful
XIII	Carcinoma of sigmoid	Obstructive resection	48	31,750	16	16	62	0	6	Retarded
XIV	Carcinoma of rectum and sigmoid	Colostomy	48	14,000	69	7	23	0	0	Pulmonary embolism, eleventh day
XV	Carcinoma of sigmoid	Obstructive resection	72	6,900	16	47	15	2	15	High temperature
XVI	Carcinoma of sigmoid	Colostomy	72	7,500	35	45	17	1	2	Retarded
XVII	Carcinoma of rectum and sigmoid	Colostomy	72	29,700	12	32	36	6	14	Uneventful
XVIII	Carcinoma of rectum, low	Colostomy	72	76,000	45	40	10	5	0	Excellent
XIX	Carcinoma of rectum and sigmoid	Colostomy	72	76,800	20	25	49	1	5	Uneventful
XX	Carcinoma of rectum and sigmoid	Abdominoperineal	72	88,400	65	15	20	0	0	Uneventful
XXI	Inflammatory lesion of cecum	Ileocolostomy	72	98,000	11	13	75	1	0	Uneventful
XXII	Carcinoma of sigmoid; perforation of bladder	Colostomy	96	16,917	58	16	14	7	5	Excellent
XXIII	Tuberculous gramuloma of cecum	Ileocolostomy	144	3,850	10	30	60	0	0	Died third day

Average total leucocyte count 44,300.

an interval of forty-eight hours. However, the percentage of histiocytes was low, giving an actual count of 5080 histiocytes per cubic millimeter of fluid. This patient did not respond to the operation so rapidly Histiocytes numbered 9600 per cubic millimeter of fluid or nearly twice as many as in Case XIII. The patient progressed excellently until the eleventh day; then pulmonary embolism occurred. Necropsy did

not disclose peritonitis. In Case xv there was little response to the vaccination after seventy-two hours. The total leucocyte count of the fluid and the percentage of histiocytes in this case were low; there were only 1100 histiocytes per cubic millimeter. A high temperature developed after operation, and the course was very stormy; eventually the patient recovered satisfactorily. In Case xvi there was a low response to administration of the vaccine, but the percentage of histiocytes was fairly high, giving a total count of 2625 histiocytes per cubic millimeter of fluid. This case might be compared with Case xiv, but the number of histiocytes was less and the clinical progress slower. In Cases xvii–xx the number of histiocytes in the fluid was large and all the patients did well. The actual number of histiocytes varied from 3500 to 57,000 per cubic millimeter. In all of these cases there were many neutrophils as well. In Case xxi, the count was very high, with 10,780 histiocytes per cubic millimeter, and a high percentage of neutrophils. The clinical course was stormy, but the lesion was very severe. Eventually recovery was good. The patient of Case xxii was vaccinated ninety-six hours before operation. There was a high percentage of histiocytes in a moderately increased total number of leucocytes. The total number of histiocytes per cubic millimeter was 9800. Clinical recovery was excellent. In Case xxiii the patient was a young woman with a large granulomatous lesion of the cecum. She was very ill before operation. Vaccine was administered intraperitoneally, but because of the patient's high temperature and poor general condition operation was not performed at the usual interval of seventy-two hours; it was performed 144 hours after vaccination. The peritoneal fluid, in spite of the vaccine, contained only 3850 leucocytes per cubic millimeter, and only 385 histiocytes per cubic millimeter. The patient did not rally from the surgical procedure and died on the third day after operation. The death and low histiocyte count seemed more than coincidental.

The average total leucocyte count of the peritoneal fluid in this second series of cases was 44,300 per cubic millimeter, nearly ten times the average in the series in which patients were not vaccinated.

To study further the changes induced by intraperitoneal vaccination, a method was devised to obtain fluid before and after vaccination of the same patient. An 18 gauge spinal puncture needle, with fitted obturator, was introduced through the abdominal wall. A small needle, also fitted with an obturator, was then passed through the large needle after its obturator had been removed. The obturator was then removed from the small needle, and adapter fitted to this needle, and suction made. A few drops of fluid were obtained in 3 cases. Use of the obturators prevented contamination of the fluid by blood from the abdominal wall. Table iii gives the details of this work. In Case xxiv, a malignant tumor had been removed from the transverse colon several years before the time of the study here reported. On examination of the patient before the operation which made possible the cell counts to be recorded, a tumor was found in the pelvis. Because of the possibility that the mass was a recurrent growth and that operation might be necessary, this patient received vaccine intraperitoneally. Before vaccination the total count was 3370 leucocytes per cubic millimeter of fluid, the percentage of histiocytes was 27 and that of neutrophils, 64. At operation, the growth was found to be a bilateral papillary cystadenoma together with tarry cysts and the products of some infection. Panhysterectomy was performed. The specimen of peritoneal fluid obtained at operation contained a tremendously increased total number of cells; the total count rose to 163,000 leucocytes per cubic millimeter of fluid. The differential count remained almost constant. Clinical recovery was excellent. In Case xxv the reaction was similar to that in Case xxiv. The patient in Case xxv had undergone subtotal colectomy for polyposis of the colon about a year before

the time of the study here reported. Vaccination was followed in 120 hours by a great increase in the total number of cells and a decrease in the percentage of neutrophils and histiocytes, but a marked increase in the relative and actual number of eosinophils. The number of eosinophils in the patient's blood was not increased. Foord, Youngberg and Wetmore found many eosinophils in ascitic fluid from fluid of man contains a moderate number of so-called white cells, but is strikingly devoid of neutrophils. Any inflammatory lesion increases the total number of cells per cubic millimeter of peritoneal fluid. If irritation or inflammation is recent, the percentage of neutrophils is found to be high; if old, the percentage of neutrophils is likely to be low. This has been shown many times in laboratory animals. The

TABLE III
FLUID OBTAINED BEFORE AND AFTER VACCINATION

Case	Lesion	Operation	Leucocytes in Peritoneal Fluid							Postoperative Course
				Per c.mm.	Differential Count, Per Cent					
					Histiocytes	Lymphocytes	Polymorphonuclears	Eosinophils	Basophils	
XXIV	Cystadenoma of ovary; tarry cysts	Hysterectomy	Before vaccination	3,370	27	9	64	0	0	Excellent
			48 hours after	163,000	27	2	71	0	0	
XXV	Multiple polyposis	Ileosigmoidostomy	Before vaccination	5,000	52	12	35	1	0	Good
			120 hours after	60,600	30	19	19	25	7	
XXVI	Tuberculosis of terminal ileum	Resection of terminal ileum	Before vaccination	2,400	21	43	36	0	0	Good
			72 hours after	17,200	30	30	40	0	0	

patients who had been subject to paracentesis a number of times. Possibly the reaction in Case XXV was similar. Case XXVI was one of tuberculosis of the terminal part of the ileum. Ileocolostomy had been performed several months before the time of the study here reported. The total cell count before vaccination was 2400 per cubic millimeter of peritoneal fluid. It increased to 17,200, seventy-two hours after vaccination. In all three of these cases the postoperative course was satisfactory.

COMMENT

The reactions found in this investigation tend to correlate with the reactions found in the peritoneal fluid of animals. As in laboratory animals, the normal peritoneal difference between the cytologic pictures of the peritoneal fluid of vaccinated and unvaccinated patients demonstrates the reaction of the peritoneum of man to foreign material to be the same as that of laboratory animals.

Several investigators have noted a difference in the phagocytic properties of the histiocytes and neutrophils, agreeing that the histiocyte has the wider range of phagocytic power. Steinberg and Goldblatt[11–13] and Morton have shown definitely that protection is much better if the interval between vaccination, and inoculation or contamination, is forty-eight hours or more. Dudgeon and Ross, Weidenreich, Nakahara, Opie, Webb, Gay and Morrison, Montgomery and others have conclusively

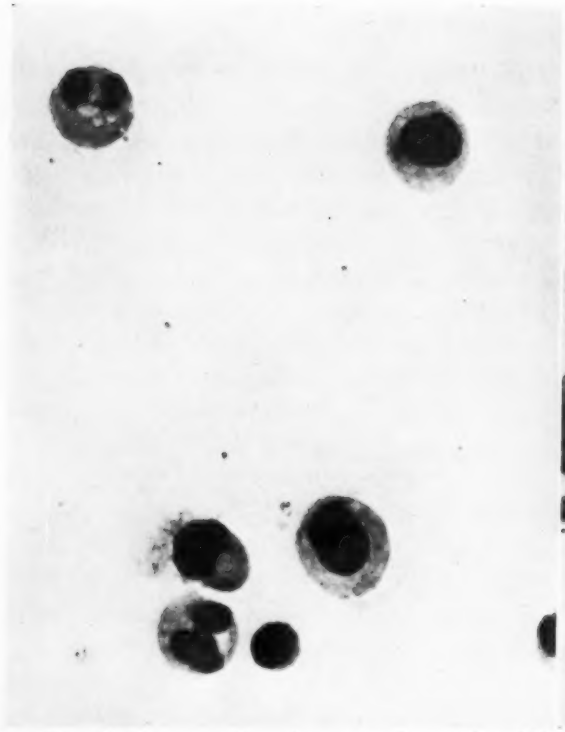

FIG. 1. Four histiocytes, a lymphocyte and an eosinophil from normal peritoneal fluid in Case 11. Wright's stain, × 960.

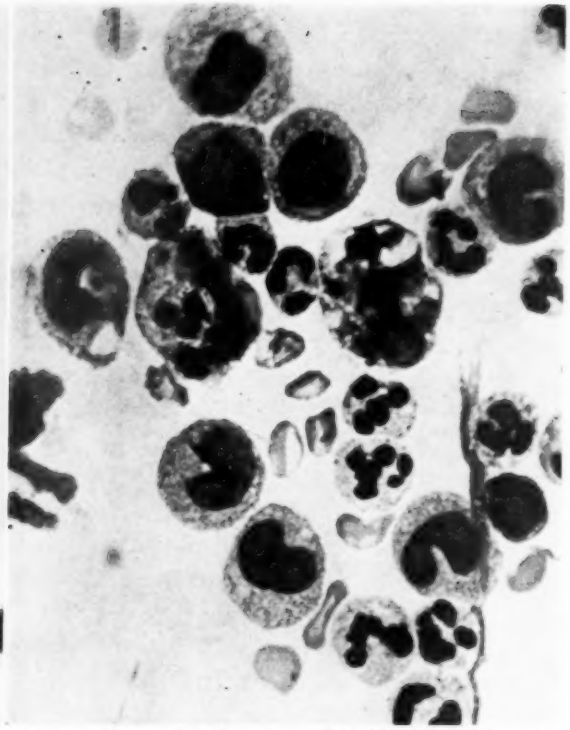

FIG. 2. Free cells of peritoneal fluid in case of carcinoma of hepatic flexure, forty-eight hours after intraperitoneal vaccination. Large, phagocytic histiocytes and some neutrophils are present. Wright's stain, × 960.

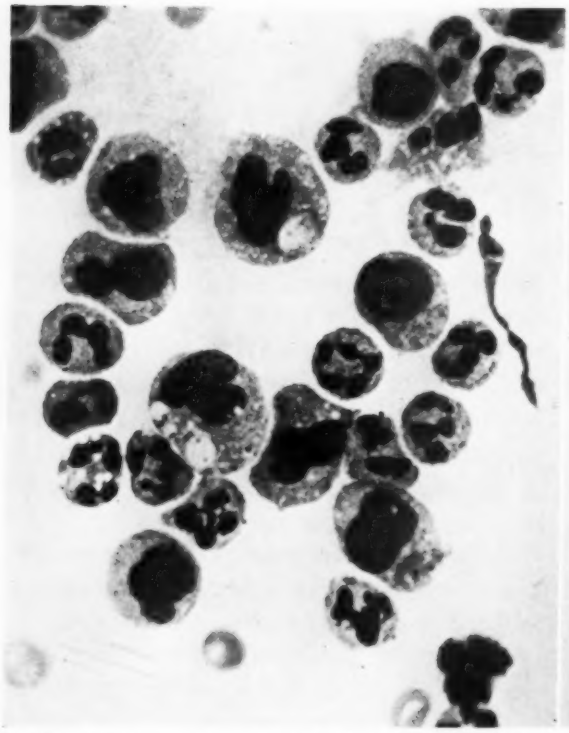

FIG. 3. Histiocytes and neutrophils of peritoneal fluid in case of sigmoidal fistula seventy-two hours after intraperitoneal vaccination. Vacuoles may be seen in some of the neutrophils. Wright's stain, × 960.

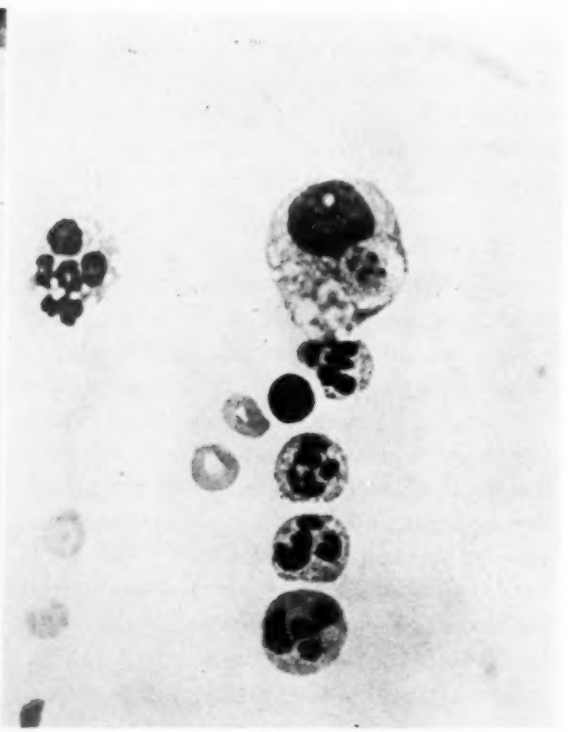

FIG. 4. Histiocytes, a lymphocyte, and four neutrophils of peritoneal fluid in case of sigmoidal fistula seventy-two hours after intraperitoneal vaccination. Histiocyte contains a phagocytosed neutrophil and other material. Wright's stain, × 960.

shown that the initial reaction to peritoneal irritation is an almost immediate influx of neutrophils into the peritoneal cavity (Fig. 2); this influx is maximal six to twenty-four hours after injection of a foreign substance. Later the number of histiocytes increases, and is maximal at about seventy-two hours; about this time the number of neutrophils falls off. It would seem to follow, then, since the increased protection accompanies an increase in the number of histiocytes and a falling off in the number of neutrophils, that the histiocytes are responsible, to considerable degree, for the protection. A slide of peritoneal fluid from a patient who has reacted well to intraperitoneal vaccination presents a striking picture. The histiocytes are seen in great numbers and are frequently seen to have engulfed a large number of neutrophils (Fig. 3), many of which seem degenerated. The impression is that the victim is fighting. It would appear that the neutrophils, ever present in the blood, are poured into the peritoneal cavity to do as much phagocytosing as possible until the stronger histiocytes appear. Later the histiocytes, which have been produced in large numbers, come in and carry on the battle, removing the débris, including the dead neutrophils (Fig. 4). If the fighting forces are already on the battle ground, as is the case after vaccination, new infection can be fought immediately instead of waiting for the stronger forces to be brought in.

Far too few cases were employed in the investigation reported here to allow any positive conclusions to be drawn as to the prognostic value of cellular reactions to inflammation and intraperitoneal vaccination. However, these few cases do suggest that the higher the total number of histiocytes following intraperitoneal vaccination, the better will be the postoperative course.

SUMMARY

This study indicates that the normal peritoneal fluid of man contains about 2300 white cells per cubic millimeter. Of these about 45 per cent are histiocytes; very few are neutrophils; a few are eosinophils and basophils, and many are lymphocytes. Inflammation causes an increase in the total number of cells; at first there is an increase in the number of neutrophils, later, an increase in the number of histiocytes. Injection intraperitoneally of a mixed colon bacillus and streptococcus vaccine increases the total cell count ten times or more, causing an early increase in the number of neutrophils and a later increase in the number of histiocytes. At least part of the protection against peritonitis afforded by intraperitoneal vaccination would seem to be the result of a non-specific production of phagocytosis, caused by an increase in the number of histiocytes.

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[For Remainder of References see p. 529.]

TRAGEDIES OF THE ABDOMINAL INCISION

J. W. KENNEDY, M.D.

PHILADELPHIA

IN one's attempt to give the profession a message, it is a very good rule never to write an article just to be writing and never to write without you are opposed in a marked degree to the popular teaching which is supposed to be of common knowledge. It is fair to assume that over 95 per cent of medical literature is compilation or restatement of medical thought with little or no change in basic principles and thus medical editors are victims of volumes of literature which is forced upon them. They have my sympathy. In these days of popular codes, it might be a good rule for medical editors to pass a law that no article would be published without the author had at least twenty years' experience in the history of the subject. It is the postoperative history and complications which teach real wisdom. The beginner has no such check on his bursting enthusiasm and thrill of expectancy.

During the past ten years I have read many papers written by able authors on the complications of the abdominal incisions.

In the January number, 1934, of the *Annals of Surgery* there are five papers written by very able men on disruption of abdominal wounds, thus the importance of the subject under discussion.

By tragedies of the abdominal incision, I would include disruption of the abdominal wound with protrusion of viscera, deaths due to infection of the abdominal incision; incisional infection and postoperative hernias, though not often surgical tragedies, come in for a word of discussion.

I feel licensed to discuss this subject because our method at the Joseph Price Hospital differs in every particular from the popular one in closing the abdominal wound. We use the through-and-through suture of silkworm gut in all cases as opposed to the terrace method with absorbable suture material.

The only buried sutures we ever use are those of silk in the incisional ventral and umbilical hernias where there has been a wide separation of the tissues, and occasionally in the 225 pound woman with an abnormally thick abdominal wall. In either type of case we always insert the through-and-through suture of silkworm gut just as though we had used no buried sutures.

Some years before the death of Doctor Joseph Price I discussed with him the subject of disruption of the abdominal wound with protrusion of viscera. He said with an experience of probably 30,000 abdominal incisions he had never had such a complication. If I am permitted to add my life's experience to that of my distinguished master, I can then say that he and I with fifty-six years' experience in abdominal surgery have not had this tragedy; this prolonged experience without such complications can scarcely be dismissed as a coincident and I believe commands interest and specially in that our method of closing all abdominal incisions is not of popular adoption and is not being taught.

DISRUPTION OF ABDOMINAL WOUNDS

Sokolov concludes from one thousand questionnaires sent out to surgeons in Europe that disruption of the abdominal wound takes place in from 2 to 3 per cent of abdominal operations. Although this may seem very high, it indicates interest and surgical concern.

The mortality from disruption of the abdominal wound with protrusion of vis-

cera from recent reports of clinics throughout the land varies from 30 to 47 per cent, so our interest intensifies.

We, as surgeons, must be more heroic as the tragedy is much our fault.

Certainly over 30 per cent of the abdo-

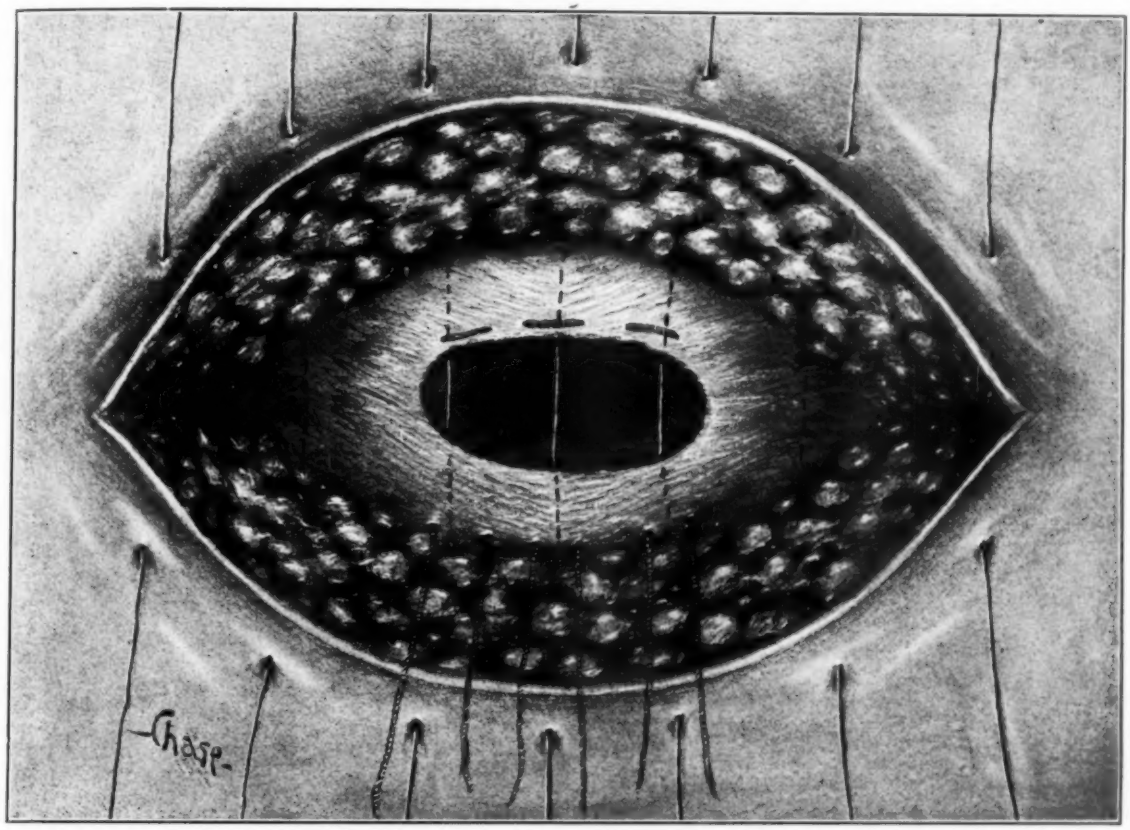


Fig. 1. Method of closing umbilical hernia, used for over thirty years in the Joseph Price Hospital, with very best results.

Incision is a transverse one; seven silkworm-gut sutures are inserted before silk staple sutures are used to close flaps of fascia. These through-and-through sutures are very necessary as they strengthen incision and get rid of all dead spaces in fat abdominal walls which are so often to be dealt with in this work. Three staple sutures are seen and are inserted so as to pull upper flap of fascia beneath lower one, which prevents pressure from above from separating flaps.

We allow from ¾ to 1 inch tissue for this overlying flap, affording plenty of room to suture margin of flap to underlying fascia as is seen in Figure 2.

The message I have in this discussion as to the cause of disruption of the abdominal wound so closely concerns the method of closure of the incision that I almost entirely exclude all prolonged discussion as to the many constitutional predisposing causes of divulsion of the abdominal incision. Therefore we dismiss a review of the constitutional etiological factors of the subject by the statement that it is only fair to assume that acute hemorrhage such as ectopic pregnancy or conditions causing a profound blood dyscrasia would cause tardy union in wound repair.

mens that are opened in the Joseph Price Hospital have been previous victims of surgery. From this experience in hundreds of cases we would say that the present day abdominal incisions are from one-third to one-half longer than is necessary. We are living in a surgical era where the blow of surgery is taken from the operator and placed upon the patient. The present-day trauma to the abdominal incision is a very unjustifiable abuse to delicate tissues which are supposed to immediately take on the process of cellular repair.

The merciless steel retractors and the tug of war that goes on between an over-energetic assistant and the natural resistance of the abdominal wall insults our idea of gentleness. Volumes have been written about trauma in surgery and its relation to surgical shock but has such discussion made gentle surgeons? I think not.

The complicated technique of the hour is traumatic in every step, too long incisions, too instrumental, too many iron hands, too much Trendelenburg position, two to three times too much time which always means trauma and exposure. The patient is a living something and not a work bench upon which we can comfortably execute detailed handicraft.

The terrace method of suturing the abdominal incisions is profoundly traumatic, in that each buried suture is in a sense a ligature and is accompanied by molecular death from the crush of tissues and the suture remains for some days a foreign body.

There is great exudation incident to buried catgut and the edema from it is probably the most potent factor in tardy healing.

The through-and-through suture has none of these untoward factors. It is entirely void of causing molecular death in the incisional surface and is a drainage

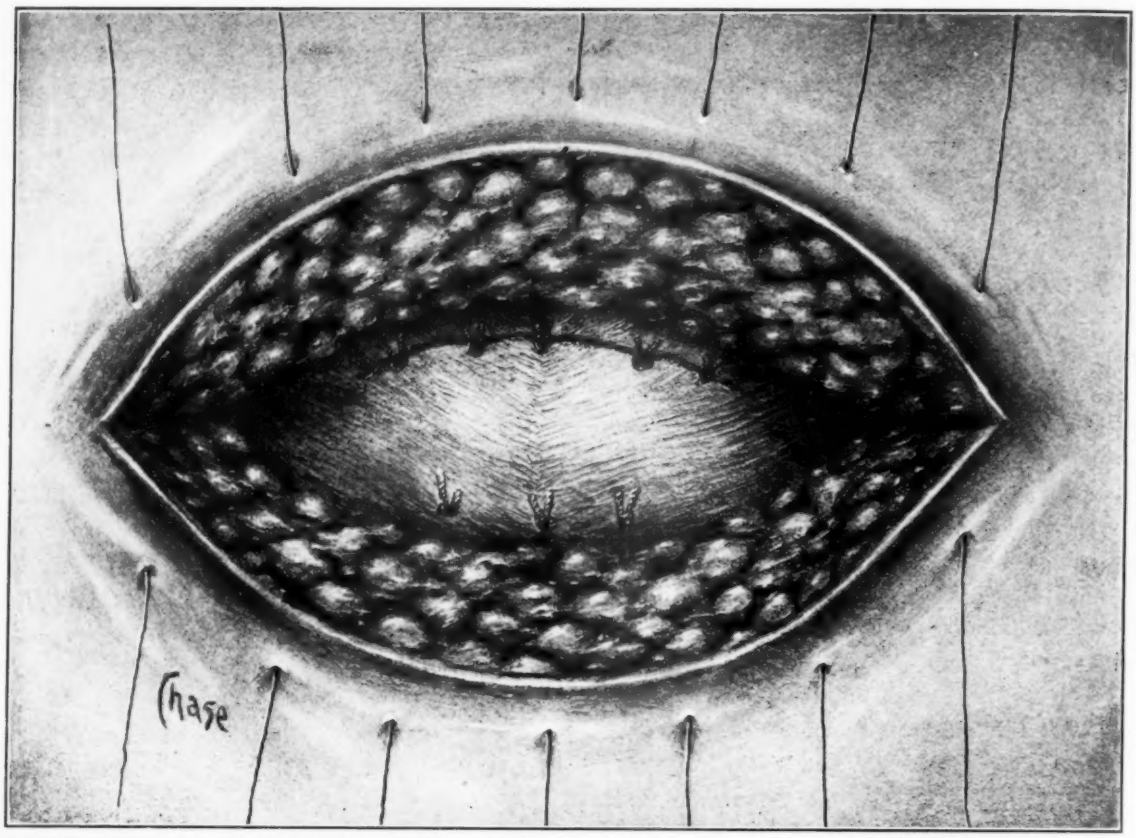


Fig. 2. Three staple sutures of silk shown in Figure 1 have been tied and are here represented by three lower knots. Any required number of such sutures may be used, as a rule five or six are sufficient for even a good sized hernia. Upper five knots represent silk sutures which were inserted to anchor upper margin of lower flap to underlying fascia. An effort should be made to have no intervening fat between these flaps of fascia as such would interfere in union.

The seven silkworm-gut through-and-through sutures have been so inserted as to close all dead spaces, which are often cause of failure, as any dead space in such low grade fatty structures is a predisposing cause to infection, which is of course fatal to any good results in this procedure. Many operators pack with gauze or drain the fatty space between skin and fascia; this I feel is a mistake as it predisposes to infection and of course is not helpful in closure and is inferior in every particular to through-and-through sutures which are a legitimate surgical factor in the closure and afford primary union.

suture. It is preeminently void of all unnecessary trauma.

I earlier stated in this article that in fifty-six years' experience in Doctor Price's and my combined work there has been no case of eventration of viscera through the abdominal incision. I had one patient, a colored woman of sixty, with history of syphilis who had a separation of the incision down to the peritoneum. The through-and-through sutures had been removed on the eighth day, a very severe attack of coughing came on as the stitches were being removed. The eighth day was rather early for the removal of the sutures and the severe attack of coughing unusual. The incision was strapped by adhesive plaster, no trouble followed.

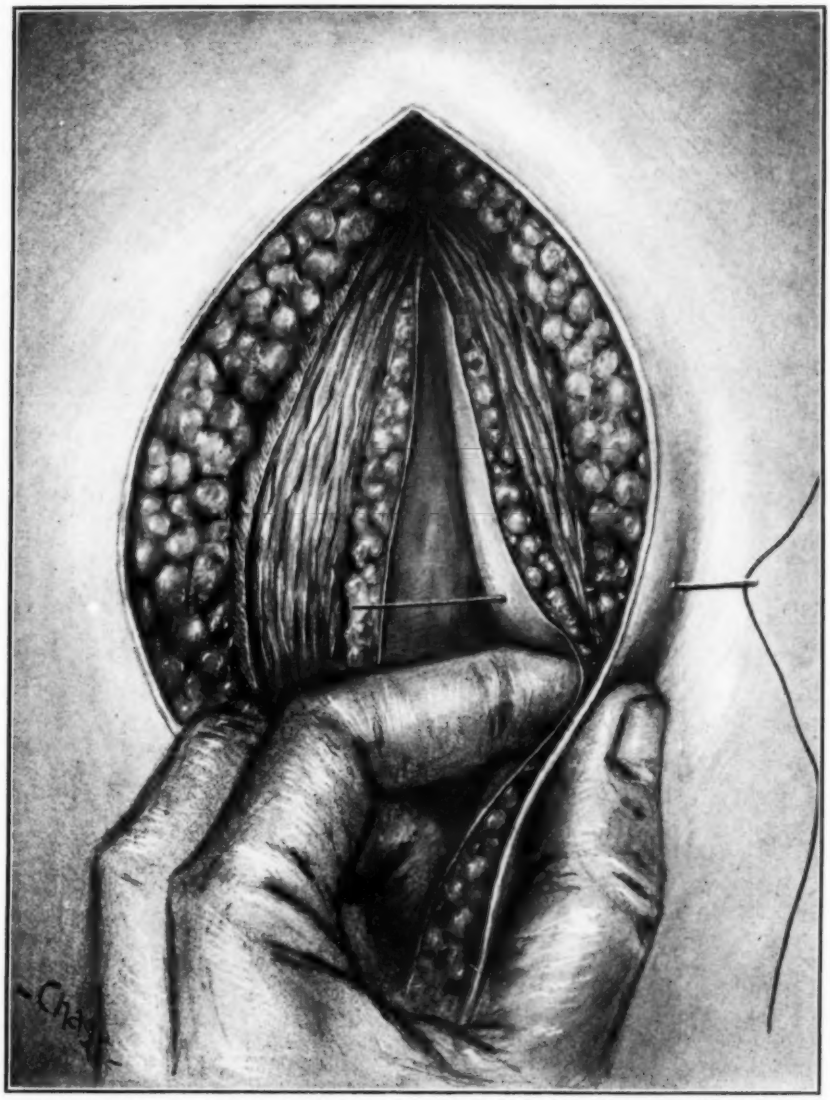


Fig. 3. Faulty insertion of through-and-through suture of abdominal wall as described in general discussion of ligatures and sutures. Index finger and thumb have squeezed back muscle and fascia and these structures upon which future strength of incision depends are in reality not included within bite of suture. Hence failure of through-and-through method of suture; whereas fault lies in technique of passing needle.

Comparison of Figures 3 and 4 speaks more eloquently than words. In referring to method of inserting through-and-through suture as seen in this figure, Dr. Price referred to such faulty method as "pinch method" of inserting sutures, as it can be seen from figure that skin and peritoneum have been literally pinched together and central structures have been pressed back of bite of suture. This is a very important step in the insertion of the through-and-through suture and much of success of method of closure of abdomen depends upon position in which these structures are held between thumb and middle finger.

Operators who use the terrace method of closure of incisions by catgut or silk lay stress on the fact that the suture placed in the posterior sheath of the rectus muscle makes traction in the longitudinal direction of the fibers of the transversalis fascia and therefore, so to speak, splits the fibers and has little retaining function.

The traction force of any kind of absorbable material is of short duration. It loses its tensile strength long before it is absorbed. Catgut's durable function cannot be measured by its life's existence, its aulling power is lost long before it is bsorbed.

Howes in the experimental department of Yale University finds plain catgut, numbers

FIG. 4. By a comparison of Figures, 4 and 3 it can be seen that middle finger instead of index finger is used and that peritoneum and skin are pushed back instead of being pinched together as in Figure 3. This permits central structures of abdominal wall; muscle and fascia, to bulge forward and thus when straight needle transfixes abdominal wall more of muscle and fascia are included within bite of suture than skin, peritoneum or fatty structures; thus muscle and fascia are butted against each other and fatty structures have been pressed back, and thus prevented from herniating between muscle and fascia, preventing union of these structures.

If middle finger instead of index finger is inserted into abdominal cavity there is not the tendency to squeeze peritoneum and skin together as shown in Figure 3 and index finger and thumb are free for other manipulating steps.

00, 0 and 1, has a tensile strength of 0 at the end of twelve hours; chromic twenty days number 1, with a normal strength of 12 pounds, in twelve hours has a strength of 6 pounds, in twenty-four hours of 2½ pounds, in thirty-six hours, 0.

Authorities differ as to the life function of absorbable sutures but it is undeniable that the durable function of absorbable materials is variable. Uncertainty is a culpable quality when dealing with life, when there is a perfectly reliable suture material.

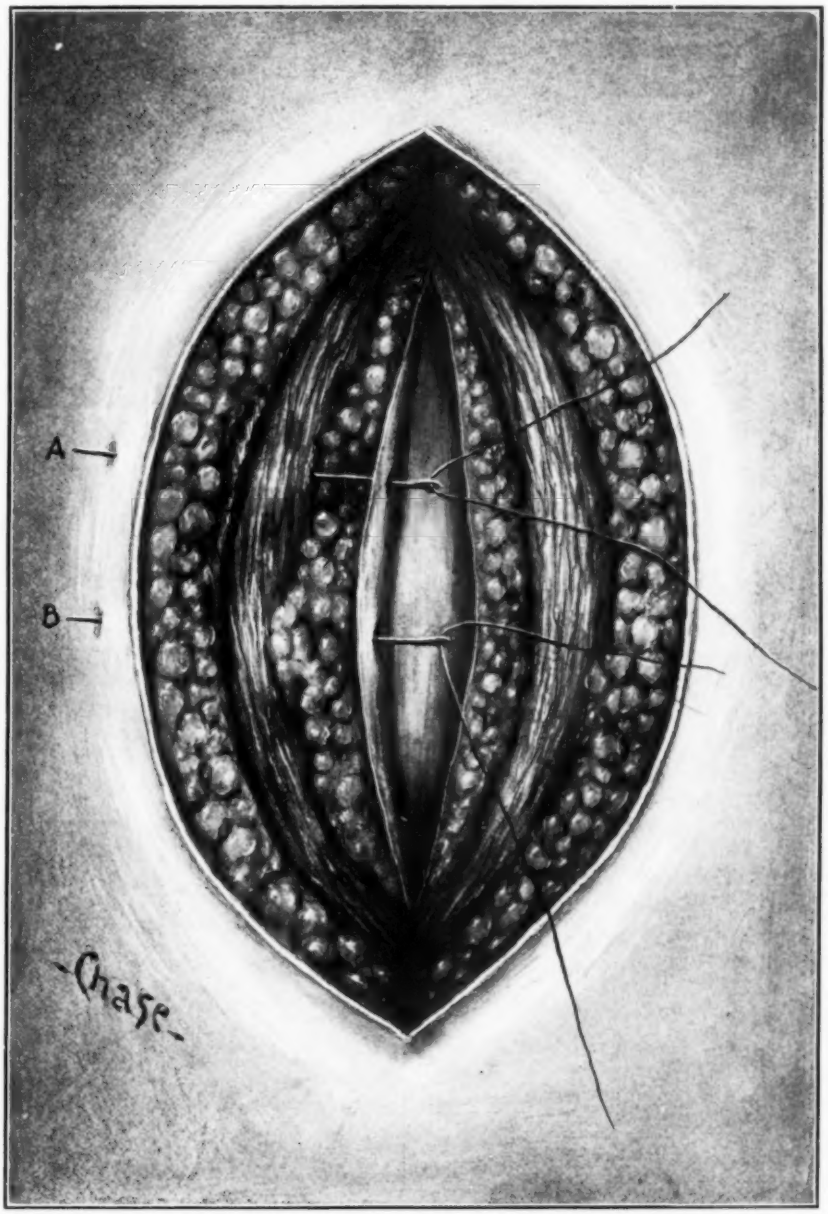
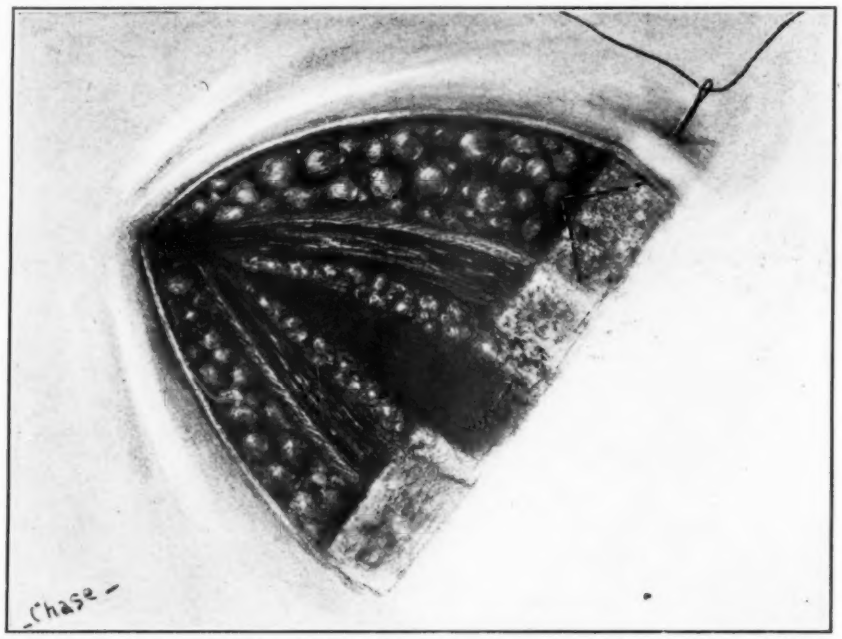


Fig. 5. Compare insertion of needle A with that of B. In case of B, fatty structures are being pressed up over surface of muscle so that when suture is tied fatty structures will not permit muscles and fascia to come in apposition and therefore, cause of hernia which may follow such faulty insertion of through-and-through suture.

Needle A is pressing back fatty structures, so when suture is tied it is impossible for fat to prevent union of muscles and fascia which are brought in perfect apposition. This is secret of through-and-through suture, which properly used has no equal. After needle A is passed through peritoneum it does not transfix preperitoneal fat but is passed over top of fatty layer and then point of needle is driven in as deeply beneath muscle as is necessary, so when suture is tightened fatty layer will be pressed back and permit muscles from side to side to come in excellent apposition.

In any type of the terrace method of suture, the retaining force of the particular suture is exerted on a single plane of tissue with a tendency to split or separate by traction the fibers of muscular fibrous or connective tissue, whereas the through-and-through suture is a mass suture welding together all structures and has not this feeble quality.



FIGS. 6 and 7. Transverse section of abdominal incision showing course of point of straight needle in order to prevent fat from protruding between sutures on skin surface or being pressed downward between muscles, thus causing failure of muscular union. If after point of needle has passed through skin, point is carried in tent shaped direction, first up, then down, these fatty structures will be held down and back, as shown in Figure 7.

Operators who are dealing with disruption of the abdominal wound will find that rarely do they experience such tragedy in the re-operation where all structure planes are welded together by fibrous tissue from previous abdominal operation. In other words, although operators had closed the abdomen by the terrace method of suture, there were not the separate planes which would be dealt with in the non-operated abdomen as fibrous tissue from the previous operation binds all anatomical planes into a fused mass.

The great amount of catgut which is being used to close the abdominal wounds when used as a continuous suture, produces a marked degree of strangulation of the included structures and thus delays healing by interference with the blood supply. It is also accompanied by the production of edema which has already been referred to as probably one of the main causes of disruption of the abdominal wound.

MORTALITY FROM INFECTED INCISIONS

In the fifty years' experience of the Joseph Price Hospital there has been no death from an infected abdominal incision, nor have Doctor Price and I in our combined fifty-six years had a mortality from the abdominal wound. Certainly such deaths should be looked upon as a surgical tragedy. I do not see how this could follow the through-and-through suture of silkworm gut. The through-and-through suture is a drainage one and in no way predisposes to deep-seated infection in the abdominal wall which may follow any type of buried suture material which is always a foreign body in a dead space, undrained.

In the terrace method of suturing, it is not the skin or peritoneal layers of suture which cause a fatal infection of the abdom-

inal wound but it is the undrained central layer of sutures which causes both the explosion of the incision and the fatal

HERNIAS DUE TO THE METHOD OF SUTURING

So few operators are using the through-

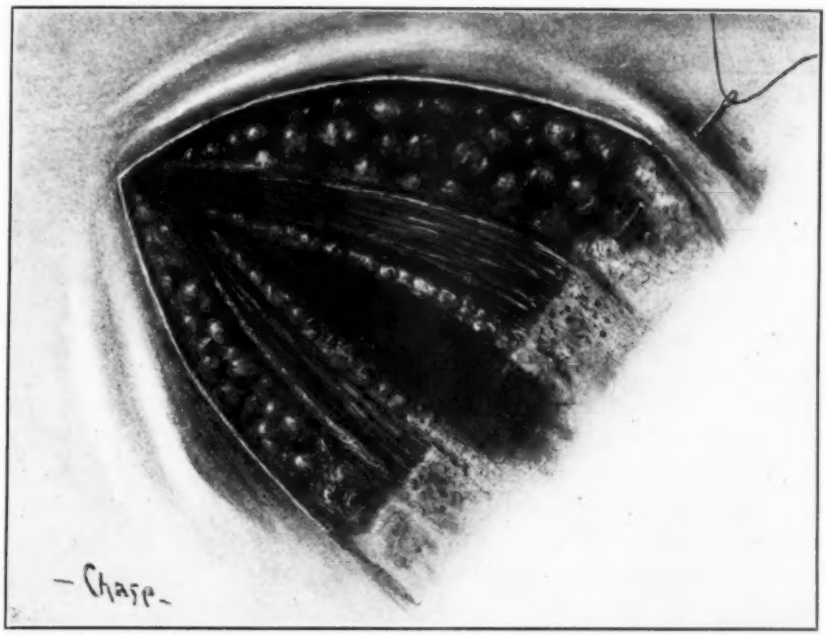


Fig. 7. Technical steps which are described take no time to execute, as steps are carried out just as quickly as one could insert any through-and-through suture, faulty or good.

If these steps are carried out as we have attempted to illustrate, surgeon cannot help but see just how such manipulation of straight needle will force useless and impeding structures back and compel strong structures to come in perfect apposition; not only is this same principle in manipulation of straight needle as seen in these figures carried out in abdominal incisions, but it is used throughout general field of surgery.

cellulitis which follows this method.

I have been astonished at the great number of deaths due to the infected incisions which have been reported in recent years. The reports of the number of infected incisions which come from our best clinics is many times that which would occur in these same clinics if the through-and-through suture of silkworm gut were used.

Sims failed to close the first vesicovaginal fistula until he found a suture material such as silver wire, which is little predisposed to infection and has a heritage of natural cleanliness. Silkworm gut is the silver wire of the day and has the same sterling qualities. Any stitch irritation of the through-and-through suture of silkworm gut clears up in a few days following stitch removal. I cannot recall at this writing a single patient who has remained in the Joseph Price Hospital on account of an infected stitch.

and-through suture that it is difficult to obtain statistics in order that we may compare this method with the terrace type of insertion of sutures in their relation to the production of postoperative hernia. Without going into painful figures, it should be of teaching force to say there has not been a closure of an undrained incisional hernia in the last fifteen years' work done in the Joseph Price Hospital where the through-and-through suture of silkworm gut is exclusively used. Possibly some unknown hernias exist. Other surgeons may have closed some of our hernias but the foregoing statement cannot be dismissed without serious consideration.

A certain surgeon reported closure of two hernias which were supposed to follow our through-and-through suture. Investigation proved that in these 2 cases no suture was ever placed, both being open treatments drained by an extensive coffer-dam

system of gauze following an operation for diffuse peritonitis.

It was not my purpose to discuss umbilical hernias but this type of hernia has many of the same surgical principles which are dealt with as those experienced in closing the ordinary ventral or incisional hernia, so I have included Figures 1 and 2, the descriptions of which are self explanatory. We must get rid of all possible abuse of tissue in the abdominal wound.

I have already referred to the trauma of the large and powerful retractors, which we never use. Too many vessels are tied in abdominal incisions, too many hemostats bite the tissue, producing molecular death. I do not believe we tie one vessel in twenty-five abdominal incisions; compare this with what is seen in most clinics.

There is too much said about a beautiful technique and a bloodless operation. Stick to your surgery but do not permit your surgery to stick to you, by which is meant, do thorough surgery but get through.

TECHNIQUE OF INSERTION OF THE THROUGH-AND-THROUGH SUTURE

All depends upon the proper insertion of the through-and-through suture. We use the long straight abdominal needle, 2½ inches in length. It is not easy to insert the through-and-through suture by the straight needle in the short incision in the thick abdominal wall and especially so if the wall is not relaxed.

I have made a considerable effort to illustrate and describe our method of suturing the abdominal wall in a monograph entitled "Practical Surgery of the Joseph Price Hospital." I have also in this monograph illustrated with considerable detail our use of the silkworm gut in the repair of the perineum. Over 60 per cent of repairs of the perineum as seen in the Joseph Price Hospital have previously been repaired by absorbable suture material, terrace method, these operations having failed in every particular.

I have no hesitancy in saying if operators had been educated in the proper use of silkworm gut as a through-and-through suture in the closure of abdominal incisions and the mass suture of silkworm gut in repair of the perineum, they would all discard all forms of absorbable suture material.

The illustrations which accompany this article show the main points to be considered in the insertion of the through-and-through suture. All depends upon the proper insertion of the needle as to the amount of tissue included in each layer of the structures which compose the abdominal wall.

The illustrations show the needle is so inserted that no fatty structures are permitted to intervene between the muscular and fascial planes and thus prevent union. This is most important. The inclusion of the tissues is barrel shaped, that is, more central structures are included than skin or peritoneum. The sutures are inserted three to the inch, little traction is made in the tying and the sutures are removed on the ninth or tenth day.

It seems to us that it is quite void of sound surgical principles to partially close an infected abdominal incision in any kind of a septic case with a terrace method of suture. Certainly the through-and-through suture of silkworm gut is indicated as each suture will take care of itself, whereas the buried suture becomes infected prolonging the drainage and is often the cause of the fatal infection of the abdominal wound.

On account of the drainage function of the through-and-through suture the operator may close many septic abdomens which would demand drainage if the terrace method of suture were being used.

SUMMARY

Under tragedies of the abdominal incision are included disruption of the abdominal wound with protrusion of viscera, deaths due to infections of the abdominal incision, incisional infection and postoperative hernias.

[Concluded on p. 538.]

AUTOGENOUS MILK VACCINE THERAPY

IN THE SURGICAL TREATMENT OF PERITONITIS

J. GORDON ANDERSON, M.D.

WESTERLY, R. I.

THE necessity for some other method of attack and control of infections in the peritoneal cavity has long been realized by the profession. Operative measures, removal of the source of the disease, intravenous injections of saline and glucose, rectal taps, Murphy drips, and Fowler's position are helpful but often prove futile in saving life. Statistics show that in the United States the mortality from appendicitis is increasing; and this means the mortality from appendicitis complicated by peritoneal infection, as the operation for uncomplicated acute appendicitis continues to show a low mortality rate. At the Clinical Congress of the American College of Surgeons in 1932, Bower[1] stated that the mortality from appendicitis in 60 cities in the United States had increased 31.5 per cent from 1910 to 1931. While faulty and incompetent surgery may be partially responsible for this increased mortality, Bower maintains that it is to be attributed largely to "prehospital factors." Chief among such factors are delay in seeking medical advice and the too frequent use of strong catharsis after the onset of appendicitis. It must certainly be admitted, however, that even in cases diagnosed early and operated in our best hospitals by our most competent surgeons, peritonitis is a too frequent cause of death. The problem of coping with an established peritonitis will probably confront every surgeon.

Recently special methods to combat peritonitis complicating appendicitis and other abdominal operations have been suggested. In France, H. Vincent[2] of Paris and other surgeons have employed an anticolibacillary or a polyvalent antigangrenous serum introduced into the operative field and given subcutaneously in appendicitis peritonitis. This method, Vincent states, has saved many "apparently desperate cases." In the United States, K. R. Ruddell[3] and his associates report the use of bacteriophage-lysed culture vaccines (colon bacillus lysates) introduced into the operative field at the time of operation in cases of peritonitis complicating appendicitis and other intestinal operations, which has markedly reduced their mortality.

The purpose of this paper is to present an additional means of treating peritonitis and thereby reducing the mortality from this disease. Active immunization with dead bacteria (vaccines) has been employed successfully in various types of infection by many workers, but not previously in peritonitis, as far as I have been able to find from the literature. For the past five years, it has been my practice to use autogenous milk vaccines in almost all septic conditions such as boils, carbuncles, streptococcic infections, cellulitis, felons, osteomyelitis, abscesses, etc., with satisfactory results. These so impressed me that late in 1929 I began to treat all peritonitis cases in a similar manner, that is, with an autogenous milk vaccine.

Immediately preceding any abdominal operation, five numbered Erlemeyer flasks,

[1] Bower, J. O. How the hospital management can co-operate in reducing the mortality of appendicitis. *Surg. Gynec. Obst.*, 56: 577, 1933.

[2] Vincent, H. Use of anticolibacillary serum in surgery. *Surg. Gynec. Obst.*, 56: 66–71, 1933.

[3] Ruddell, K. R., Sicks, O. W., and Loomis, N. S. Bacterial lysates in surgical cases. AM. J. SURG., n.s. 22: 337 (Nov.) 1933.

each containing 30 c.c. of milk, are boiled and sterilized for thirty minutes in an electric sterilizer and then allowed to cool. A thin skin may form on the surface of the milk. This is removed with a sterile platinum loop.

The sterile flasks are then set on a sterile side table. If, on opening the abdomen, a local or general peritonitis is present, cultures are obtained with a sterile spoon or platinum loop. If there is much peritoneal fluid present about 4 drams of the fluid are used to inoculate the milk in each flask. Cultures can also be obtained by dipping the blind end of the appendix after removal into the sterile milk. These flasks are then corked and placed in an incubator at 37.5°C. At the end of twelve hours Flask No. 1 is removed from the incubator and sterilized by boiling over a direct gas flame for five minutes. If a curd forms either before or after boiling it is removed by filtering through sterile cotton and the filtrate is used for injection. This curding is quite frequent in cultures incubated for thirty-six hours or more. Some cultures develop a very sour lactic acid odor. In others there is very little change in the gross appearance. Flasks with milk cultures No. 2, 3, 4, and 5 are removed in twenty-four, thirty-six, forty-eight, and sixty hours, respectively, treated and injected if deemed necessary as described for Culture No. 1. All milk cultures are killed by heat at the end of four days' incubation as it is my opinion that maximum growth has been obtained by that time. Chemical changes occur which retard the growth of the bacteria and undesirable products of fermentation may result. The filtrates of these four-day cultures are kept in sterile sealed bottles on ice for future use if necessary.

The short period of sterilization of the autogenous milk vaccine has been criticized by pathologists in that gas bacilli might be injected with disastrous results. Probably longer sterilization may be employed without impairing the potency of the vaccine. This can be determined by bacteriologists in a study of a greater number of cases.

Injections are given intramuscularly in the gluteal region, as this gives a wide area for absorption. Care should be taken never to inject the vaccine material directly into the blood stream. There should always be ready a hypodermic syringe containing 10 minims of adrenalin hydrochloride to be given if any anaphylactic signs or symptoms appear. The amount of vaccine injected should be determined by the condition of the patient; from 10 to 25 c.c. have been employed in the cases treated at each injection, usually 15 c.c. or more. Two or three injections have been given as a rule.

It has been suggested that sterile milk injected in the muscles will give similar beneficial results as the autogenous milk vaccines. This I have tried on many other types of infection, as in cases of salpingitis, widespread cellulitis, severe mastoiditis, osteomyelitis of the long bones, etc. The stimulation of the defensive mechanisms of the body, such as chills, rise in temperature, increased leucocytosis, etc., will be enhanced by a non-specific foreign protein in some cases but for lysis of the invading bacteria in severe infections, the production of the specific antibody can be brought about only by the injection of the specific bacterial protein.

In 18 cases of appendicitis with localized or generalized peritonitis treated by this method there was only one death. In the 17 cases that recovered drainage was observed to be much less than usual in such cases, and recovery was more rapid. In the fatal case, the patient had had acute pain in the lower right quadrant for five days before coming to the hospital and had taken Epsom salts; at operation an extensive peritonitis with a great deal of free pus was found. In one case (Case 18) with generalized peritonitis, about 10 c.c. of peritoneal fluid were removed and suspended in 20 c.c. sterile saline. This was boiled for thirty minutes and filtered; the filtrate was injected intramuscularly

in the gluteal region an hour after the patient recovered from the anesthesia. The autogenous milk vaccine was given subsequently. The patient made a rapid recovery. The following cases are reported in further detail to illustrate the type of case treated and the results obtained with the autogenous milk vaccines.

Case I. E. M., female, aged ten years. Five days prior to entry to the hospital, she had complained of pain in midepigastric region, malaise and constipation. The day before entry she had taken a tablespoonful of castor oil. This was followed by an acute pain in the right lower quadrant, nausea and vomiting, but no bowel movement. Physical examination showed a distended, tympanitic, tender and spastic abdomen, with signs aggravated over McBurney's point; rectal examination caused pain. Temperature, 102.4°F.; pulse, 130; respiration, 28; leucocyte count, 18,400.

Immediate operation was done and a gangrenous ruptured appendix removed. A thin serous exudate without odor was present in considerable quantities, the omentum inflamed and edematous, the bowel red; there were no adhesions. Fluid was obtained for inoculation of the milk; and smears from the peritoneal cavity that subsequently showed a predominance of chains of streptococci. A drain was inserted in the pelvis and another in the region of the cecum; and the abdomen closed. The patient was put in Fowler's position, intravenous glucose and saline given and repeated in twenty-four hours; morphine, 1/8 grain every four hours; heat applied to the abdomen.

In twelve hours, 25 c.c. of the autogenous milk vaccine was given; and three hours later another injection in the opposite gluteal muscle, as distention of the abdomen was increasing. Thirty-six hours after operation the abdomen was quite soft, the skin moist with free perspiration, the temperature falling and the pulse good; a third injection of the milk vaccine (15 c.c.) was given in the muscles of the back. A rise of temperature on the eighth and ninth days subsided after freeing the drains and giving a soap and water enema. Local reactions appeared at the sites of all the vaccine injections.

The patient was discharged on the seventeenth day with the wound practically healed.

Case II. F. W., male. The patient drove to Westerly, R. I., from Northampton, Mass., after he had been told by physicians he had acute appendicitis and peritonitis. He gave a history of acute abdominal pain for forty-eight hours with nausea, vomiting, fever and chills; bowels had not moved for three days in spite of liberal catharsis. The whole abdomen was distended, tympanitic and tender, with tenderness most marked over McBurney's point; rigidity and spasm of right rectus muscle. Temperature, 102.8°F.; pulse, 120; respiration, 26; leucocyte count, 24,000; tongue dry and coated; eyes glassy and bright; face had a pinched appearance. Lungs and heart normal; urine negative.

Normal saline (350 c.c.) and glucose (50 c.c.) were given intravenously before operation. At operation, the peritoneum was injected, the bowel red; no adhesions; the peritoneal fluid was thin and serous without odor; milk cultures were made and smears obtained which showed streptococci in chains predominating. Drainage was instituted.

Three injections of the milk vaccine were given at twelve to sixteen hour intervals. There was a rapid fall in temperature within thirty-six hours and marked perspiration. The abdominal distention was slow in subsiding in spite of the use of pituitrin and heat; the temperature showed variations for seventeen days. On the sixteenth postoperative day another injection of 18 c.c. of the autogenous vaccine was given and the temperature became normal in twenty-four hours.

The patient was discharged in good condition on the twenty-fifth day.

Case III. M. B., female, married. The patient was ill for five days with abdominal pain, nausea and vomiting, chills, and fever; she had taken Epsom salts and other cathartics; her husband attributed the symptoms to lead poisoning as the house had been painted. Abdominal pain, tenderness and rigidity were present, most marked in the lower right quadrant; rectal examination caused pain on the right side. Temperature, 102.8°F.; pulse, 120; respiration, 32; leucocyte count, 14,600. Urine negative. Normal saline (350 c.c.) was given before operation. At operation a ruptured appendix was removed; there was general peritonitis and thick pus with the characteristic foul colon bacillus odor. Drainage was instituted. Autogenous milk vaccine was given twelve, twenty-four and thirty-six hours post-

operatively. The usual drop in temperature occurred, and the patient was discharged in twenty-three days in good condition.

Case IV. A. S., female, married. She had an acute pain in the right lower quadrant two weeks previous to admission to the hospital, diagnosed as pus tubes and pelvic peritonitis; treated by douches and heat to the abdomen. Pain continued, becoming more severe; no bowel movement for five days; enemas were given but no cathartics. She had had four previous attacks diagnosed as appendicitis by her family physician. On admission the abdomen was rigid and tender, with tenderness most marked over the appendix; pelvic examination negative. At operation a ruptured gangrenous appendix was removed. Many adhesions were present binding down the appendix, which was retrocecal. General peritonitis was present and pus had characteristic colon bacillus odor. Two injections of 25 c.c. each of the autogenous milk vaccine were given twelve and twenty-eight hours after operation; a third injection of 10 c.c. at forty-eight hours. Patient discharged in good condition on the thirty-second day.

In conclusion, I would emphasize the following points:

Milk was chosen as the most suitable medium for the following reasons:

1. Most pathogenic bacteria grow quickly in it.
2. There is obtained a non-specific foreign protein reaction which may in itself be beneficial.
3. It is a medium which can be universally obtained.
4. It needs no preparation except boiling over a direct flame for five minutes, or autoclaving for fifteen minutes or by steam for thirty minutes in an ordinary sterilizer.

The earlier the injection of the dead bacteria that are derived from the peritoneal fluid is given, the quicker will be the lysis of the invading organisms and the recovery of the patient. The rapidity with which the cultures grow is a vital factor for, in the case of a widespread peritonitis, a vaccine potent enough to take effect in twenty-four to seventy-two hours is absolutely necessary, as in many of these cases death occurs within this time. Large amounts of vaccine are injected to insure quick absorption in order to stimulate the rapid development of specific antibodies that will combat the infection present in the abdomen. This method is practical for every surgeon in any hospital; and its use is indicated in all appendix cases where there are any signs of peritoneal infection, whether drainage is to be used or not.

SUMMARY

The danger from peritonitis in appendicitis and other abdominal operations and the need for a more satisfactory treatment of this complication are emphasized. A new method of treating appendicitis at abdominal operations by intramuscular injection of autogenous milk vaccine is reported. The method of preparing the milk vaccine with material from the peritoneal cavity is described, and the advantages of milk as a culture medium noted. Eighteen cases of appendicitis with local or generalized peritonitis treated by this method are reported; of these 17 patients recovered and one died. Four of these cases are reported in further detail to show the type of case treated and results obtained with this vaccine treatment.

SUGGESTIONS TO FACILITATE THE USE OF

SURGICAL MAGGOTS IN SUPPURATIVE INFECTIONS*

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IN the maggot treatment of infected wounds, introduced to surgery by Baer,[1] living sterile maggots are implanted in the surgically prepared wound. The presence of actively functioning maggots within the wound appears to be an essential part of the treatment[7,9]; and although attempts have been made to obtain the same excellent results with maggot extracts, no convincing evidence has yet been given that the living maggots can be eliminated.

In a treatment of this kind certain problems of a biological as well as a clinical nature are bound to arise, and the present article is a discussion of these questions from the biological standpoint. As living maggots are at present an integral part of the treatment, the success of the method depends largely upon having conditions in the wound suitable to their requirements.

POSTOPERATIVE TREATMENT

Before the maggots are implanted a radical operation is performed to remove sequestra and devitalized tissue, and to establish adequate drainage. A discussion of the operative procedure employed in cases for maggot treatment is given in a number of articles.[1–3,5,10]

As maggots do not function well in the presence of blood, it is advisable to use vaseline gauze when packing the wound in order to reduce hemorrhage when the packing is removed. A minimum quantity of vaseline should be used as it is unfavorable for maggots.

MAGGOTS ARE SURFACE FEEDERS

Maggots feed only on the surface or in shallow openings, and do not penetrate deeply into a sinus. It is essential that the maggots be given access to all infected parts. Thorough exposure of the infected tracts at the time of the operation, whenever possible, is therefore advised, as the maggots cannot be relied upon to reach such areas unaided.

During treatment the wound tends to close in some cases, which forces the maggots to leave the deeper parts. Various devices have been used to keep the wound open. Strips of adhesive plaster attached to the outside edges and fastened down so as to pull the wound open have been used in shallow wounds. Metal retractors such as those described by Weil,[11] which are allowed to remain in the wound, have given some satisfaction for deep wounds. Buchman* has used blocks of sponge rubber for this purpose with success.

PROTECTION OF SKIN FROM MOVEMENTS OF MAGGOTS

Maggots sometimes move about upon the skin around the wound within the limits of the retainer, especially if conditions in the wound are unfavorable for them. It is therefore customary to protect the exposed skin so as to prevent irritation by these movements. This serves a double purpose, since it also prevents irritation by wound secretions which are usually very copious under the maggot treatment.

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* From the Division of Insects Affecting Man and Animals, United States Bureau of Entomology.

A layer of adhesive plaster or a coating of collodion has been tried extensively as a skin protection, but they have not been found to be generally satisfactory. They both tend to separate from the skin when they become wet, thus allowing the maggots and the secretions to get in under them. It is also somewhat painful to remove them when dressing the wound.

Excellent results in protecting the skin from both the crawling of the maggots and the irritations of the wound secretions have been obtained with the liquid adhesive mentioned by Buchman and Blair,[2] and with Unna's paste described by Jewett.[4] The formula for the latter is given in a following section. Either of these coverings can be removed with warm water and they have no ill effect upon the skin.

IMPLANTATION OF MAGGOTS IN THE WOUND

When bleeding has ceased, usually three to five days after the operation, the vaseline gauze packing is removed. Unless fresh bleeding takes place, the wound is ready for introduction of maggots. Blood in the wound reduces the effectiveness of the maggots and causes them to attempt to escape. Transference of the maggots from their containers to the wound is done with care to avoid contaminating them, but it is not necessary to use the aseptic precautions of the operating room. A satisfactory method of implantation is to take the maggots to the bedside or dressing room in their food bottles. Sterile water is then poured into the bottle and stirred slightly with an applicator. The maggots are next poured on to sterile gauze over a beaker or dressing jar and washed to separate them from the remains of the food. Warm water should not be used as it activates the maggots and causes them to scatter. A final rinse with cold water will subdue them so they can be transferred to the wound with a tongue depressor, spatula, or spoon. A small quantity of food transferred with the maggots has not been found harmful to the wound. Buchman[2] drops the gauze with the maggots directly into the wound and removes it at the next dressing. This considerably shortens the process. If only a small number of maggots are needed, they can be removed from the bottle conveniently with a cotton-tipped sterile applicator.

AVOIDANCE OF OVERCROWDING

The number of maggots to place in the wound can usually be determined without difficulty after a brief experience. In some of the early cases the wound was entirely filled, but that led to considerable trouble. It is important to avoid filling the wound with young maggots. The tendency is to use excessive numbers; but as growth occurs very rapidly, the maggots are often crowded from the wound. This causes them to escape from the cage, if at all possible, and to wander over the skin and get into the bed. An infected finger-tip may require as few as 5 or 6 maggots, while for deep femur wounds 500 to 600 may be needed. As it is impossible to count the maggots at this time the best course is to leave a good margin between the number of maggots and the extent of the feeding surface in the wound.

When the wound begins to heal the number of maggots used should be reduced. They feed only upon the purulent and necrotic material, which is diminished as healing progresses. Excessive irritation can be caused by the wandering of maggots within the wound if the number used is out of proportion to the available food.

The longer the period that maggots can feed in the wound during an implantation, the greater is their usefulness. For this reason they should be only partly grown when implanted. A length of from 4 to 6 mm. is quite suitable. Specimens of smaller size are more difficult to transfer and more likely to escape.

MAGGOT RETAINERS OVER THE WOUND

A cage or retainer of some sort over the wound is advisable, as the maggots tend

to wander for a time after implantation. Fine copper wire gauze, 60 mesh, was used by Baer.[1] The screen was cut the shape of the wound but larger. A strip of sponge rubber was sewn around the lower margin to serve as a cushion. Modifications of this type of cage are still used, but they have certain objections. The adhesive plaster used to bind the cage to the wound sometimes irritates the skin, and it tends to loosen and lift from the skin where the drainage flows. This cage is also somewhat expensive and inconvenient to handle.

Jewett[4] has used Unna's paste with excellent results for fastening the cage down, and has eliminated the rubber cushion. His formula for the paste is:

Zinc oxide.....	2½ parts
Gelatin.....	6¼ parts
Glycerin.....	19 parts
Water.....	19 parts

The solution should not be too thin or it will run down over the skin and also into the wound, but when of the right consistency it seals the skin very effectively and also keeps the cover of wire or gauze glued down. Of course it should be applied warm. We have seen no ill effects from a little getting into the wound.

A very simple and convenient retainer is described by Buchman and Blair.[2] After implantation the edges of the wound are painted with a liquid adhesive and a piece of fine muslin is spread over the wound. Besides being easy and rapid to apply, this method has the additional advantage of costing considerably less than the wire screen and rubber arrangement.

For terminal wounds a different type of retainer is necessary. A satisfactory method used by Maddock* is to fasten wooden tongue depressors with adhesive plaster along the sides so that the ends project beyond the wound. Crinoline gauze is then gathered over the wound and fastened down with adhesive plaster bands. The stips of wood support the gauze and keep it free of the wound. Robinson* has found that for certain locations, such as the posterior aspect of the heel, a raised type of cage gives good results. The cage is made by gently pounding fine metal screening of about 60 mesh into a hole in a piece of soft pine with another piece of wood of slightly smaller dimensions. Any shape cage can be made in this way.

In cases for intraoral treatment, Ochsenhirt and Komara[6] used the following method: After the operation for removal of the dead tissue

> . . . an impression of the involved area is made, and a cage or denture constructed. A metal tube is embedded in the cage running from the base, where it opens into the area of bone involved, to the upper portion, where it protrudes from the mouth. Maggots are applied through this tube, thus permitting direct contact with infected bone. To insure constant pressure on the apparatus, preventing escape of maggots into the oral cavity, Jelenko splints are applied to both jaws. Orthodontic rubber bands are then attached between both splints, causing firm closure of the jaws. In the treatment, a cap in which 80 mesh copper screen had been soldered is fastened over the metal tube after the maggots have been applied.

MAGGOTS WILL NOT FUNCTION IN ACCUMULATED WOUND SECRETIONS

A serous exudate is secreted freely by the wound under maggot treatment, and if allowed to accumulate it will cause the wound to become unfavorable for maggots. Excessive secretion in the wound will force the maggots to cease their feeding and attempt to excape, and if they cannot get away they usually die in the wound. This, of course, reduces the efficiency of the treatment; it retards the healing process; and it adds to the cost of the treatment.

Adequate drainage of the wound is therefore of especial importance in the maggot treatment. A method which is usually satisfactory is to allow the discharge to run out of the wound by gravity wherever this is possible. Other methods are aspiration, sponging, and pipetting, all

* Dr. Stephen Maddock, Boston City Hospital, Boston, Mass.

* Dr. Wilson H. Robinson, Pittsburgh, Pa.

of which require frequent attention but are sometimes necessary in deep wounds that cannot be drained by gravity.

The only way to get maggots to work in the deeper infected sinuses is to expose these tracts surgically and keep them free from secretions. Otherwise the maggots will be forced to feed around the upper surfaces, thus causing premature healing and development of granulation tissue there; whereas it is admitted that healing of the wound must proceed from the bottom upward. One of the chief reasons for the trouble caused by the early closing of the wound under the maggot treatment is undoubtedly inadequate drainage.

LIGHT

Maggots have no eyes and do not require light for their activities. They are repelled by light and normally move away from it. A light is sometimes used over the wound, but this is not needed to drive the maggots down into the wound, because they will go down naturally if conditions in the wound are favorable for them.

REMOVAL OF MAGGOTS

The length of time to leave maggots in the wound is usually three to five days, depending partly upon their size when implanted. In nature they leave their food when full grown and finish their development in the ground. It is advisable to remove the maggots from the wound before migration, otherwise they will escape if possible and cause considerable annoyance to the patient. If they cannot escape they will die in the wound, but their efforts to get out can be very painful to the patient. The maggots are removed by washing the wound with sterile water or saline. If any are still feeding deeply they can be extracted with forceps or applicator. It is often advisable to allow the patient a day to rest between implantations.

NUMBER OF IMPLANTATIONS

Typically, as the wound begins to heal it becomes less favorable for maggots, as they feed only upon the necrotic and purulent materials present; and a time therefore comes when maggots are no longer useful. This differs of course with each case. The cleaning up of the wound and the growth of granulation tissue are indications that the maggot treatment can be reduced or stopped. Maggots require relatively enormous quantities of food,[7] and unless it is available they will either escape or die in the wound. As suitable food is lacking in the clean wound, the use of maggots at this time would only cause unnecessary annoyance to the patient. The number of implantations which can be used to advantage is therefore limited. It may range from 3 to 20 or more.

NO DANGER OF PARASITISM

Maggots of the species *Lucilia sericata* and *Phormia regina* are the ones commonly used in the Baer treatment. They remove only the devitalized tissue, the pyogenic bacteria, and the pus from the wound; and they do not normally attack healthy tissue. They must also leave the wound in order to finish their development. Therefore there is no danger of parasitism within the patient or of injury to the tissue through neglect to remove the maggots. There is grave danger, however, in the use of the screw worm (Cochliomyia americana), and that species must be carefully avoided.

SUPPLY OF SURGICAL MAGGOTS

Sterile maggots can be purchased ready for use from certain medical supply houses. They are also being reared privately in many hospital laboratories; and unless a very small supply is needed this is usually a less expensive and more convenient way to procure them. With the proper equipment and training, the private production of maggots is quite practicable. Circular E-311 of the Bureau of Entomology[8] gives detailed instructions upon the culture of sterile maggots.

SUMMARY

The use of living maggots in the treatment of infected wounds involves certain problems of a biological, as well as a clinical nature. In this article a discussion is given of such questions as the inability of maggots to reach deep necrotic areas without surgical assistance; the unfavorable effect upon maggots of accumulated wound secretions; the implantation of maggots in the wound; the need of avoiding the use of excessive numbers of maggots in the wound; a description of various types of maggot retainers over the wound; removal of maggots; why they sometimes die in the wound; and why they sometimes escape from the wound.

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*Continued from p. 511.

DETECTION OF OCCULT BLOOD IN FECES*

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THE clinical value of tests for occult blood in the feces ranks with that of tests for albumin and sugar in the urine. Gross hemorrhage into the gastro-intestinal tract and comparatively small hemorrhages occuring at or near the anus are readily discovered by the mere inspection of the stool, but considerable bleeding, frequently large enough to cause severe secondary anemia, may occur in the upper intestine or in the stomach without any visible manifestation in the feces.

Since Van Deen introduced the guiacum-turpentine reaction, several different modifications of this test as well as other tests based on the same chemical principles have been used extensively in the study of gastrointestinal disease.

Nearly all of the chemical tests for occult blood in the intestinal contents are based on the detection of small amounts of an enzyme, peroxidase, which is present in blood, and some other organic materials. A colorless base such as guiacum, guiaconic acid, benzidine, ortho-tolidin, or reduced phenolphthalein which becomes highly colored when oxidized, is added to the material to be tested. When a peroxide is added nascent oxygen is liberated if a peroxidase is present. The nascent oxygen in turn oxidizes the colorless base to the colored compound.

Benzidine or guiacum as the colorless base and hydrogen peroxide as the substrate for the peroxidase are the reagents most commonly used in clinical laboratories for the test. In 1912, Ruttan and Hardisty[1] reported the use of ortho-tolidin instead of benzidine or guiacum, but their report appears to have escaped general attention and tolidin has been little used as a reagent in the test for occult blood. To call attention to the advantages of the tolidin reagent is one of the purposes of this paper.

Some modifications of the benzidine and guiacum tests have been criticized as being too delicate for clinical use. Although the results of the more sensitive test may be more difficult to interpret it may be contended that no test is too sensitive provided it does not give false positive results, since in many instances even a minute amount of blood in the intestinal contents is worthy of detection. Any test which does not give positive reactions with normal stools when meat is included in the diet is not sufficiently delicate for clinical use. For the correct interpretation of the results it is not only necessary to eliminate meat and fish from the diet, but blood from the nasopharynx, gums, trauma from the use of a stomach tube and bleeding from rectal and anal sources require consideration.

The actual amount of blood detectable has been studied in our Clinic and has been the subject of some previous investigation. Bramkamp[2] found that minute traces of blood in water could be detected by the benzidine test which gave positive reaction in a dilution of 1:25,000. When fresh blood was mixed with feces a proportion of at least .08 c.c. blood per 200 gm. of feces was necessary to give a positive test, indicating that there are substances in the feces which tend to inhibit the reaction. Bramkamp also found that when blood is ingested, ninety times as much blood was necessary to give a positive test as

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was necessary when fresh blood was mixed with feces. Three and a half grams of blood or sufficient to amount to 3.6 per cent of the weight of the stool gave a positive reaction, while smaller quantities were not detectable. This finding indicates that blood passing through the gastrointestinal tract loses a large measure of its power to reduce peroxides.

In the experiments reported in this paper, the stools were tested by three different tests in order to determine the actual and relative sensitivity of the tests used. The tests compared were the benzidine test, tolidin test and the spectroscopic test for hematoporphyrin. The latter test is of particular interest because it is based upon an entirely different chemical reaction than the other two procedures and since it does not react positively to fresh or undigested blood it is of value in determining the level of bleeding in the intestinal tract. Hematoporphyrin is a product of the digestion of hemoglobin, consequently undigested blood from the rectum and lower colon does not give positive tests.

The spectroscopic test was performed as recommended by Ryffel,[3] by transferring 3 or 4 gm. of feces to a test tube. About 8 c.c. of glacial acetic acid was then added and the stool emulsified by means of a stirring rod. About 10 or 12 c.c. of ether was then added, the test tube was stoppered and shaken for about one minute. If the proper proportions of ether and acid were not present the separation did not take place and it was sometimes necessary to add a few cubic centimeters of water to bring about a satisfactory separation of the ether layer. The ether layer was transferred to another test tube and approximately 4 c.c. of 20 per cent hydrochloric acid was added, the tube stoppered and shaken for about two minutes. After separation of the two layers the bottom layer was examined by means of a hand spectroscope and strong transmitted light for the characteristic absorption bands of acid hematoporphyrin.[4]

The benzidine reagent was prepared by shaking up approximately 0.1 gm. of powdered benzidine with 3 c.c. of glacial acetic acid and adding an equal volume of fresh solution of hydrogen peroxide. A few drops of this freshly made reagent was added to a small particle of feces. If the reaction was positive a blue color appeared within thirty seconds and usually faded within a few minutes. A brown color was not considered positive.

The tolidin reagent was prepared by dissolving 1 gm. of ortho-tolidin in 25 c.c. of glacial acetic acid. This solution keeps well for at least two weeks. Just before use equal volumes of this solution and a fresh solution of hydrogen peroxide were mixed and the resulting reagent was used exactly as was the benzidine reagent. If blood is present a deep blue color develops within a few seconds and becomes deeper on standing instead of fading.

Besides the application of the benzidine and tolidin reagents to the solid stool these reagents were used for ring tests by layering over the reagent in a small test tube a small amount of the ether extract prepared in the spectroscopic procedure. A blue ring at the juncture of the two liquids indicated a positive reaction and was found to be a very delicate test.

A comparative study of the sensitivity of these tests was carried out by running parallel tests on the stools of subjects who were ingesting known amounts of blood with their food. The subjects used were normal individuals without gastrointestinal symptoms without hemorrhagic lesions in the mouth, nose or anal region. They were kept on a diet entirely free of meat or fish and almost entirely free of green vegetables. All the stools were examined and as soon as the stools became consistently negative to all the tests used, measured amounts of the subject's own blood were added to the meals. A daily intake of blood was established at certain levels by dividing the daily dose into three amounts to be taken immediately after meals. As soon as stools representative of a given rate of blood ingestion were

obtained for examinations the dosage of blood was increased. Wood charcoal and carmine were used to mark the stools.

The results of the experiments on three subjects are recorded in Tables I, II and III. In summarizing these results it can be stated that the ordinary method of testing stools by the direct application of the reagent to the feces is definitely more sensitive when tolidin is used instead of benzidine. With the benzidine reagent at least 5 c.c. of blood per day taken in three equal doses with the meals are necessary to give a positive test, while with the tolidin reagent from 2 to 4.5 c.c. of blood gave definitely positive reactions. In the comparison of the two reagents an additional advantage of the tolidin reagent over the benzidine reagent was the more definite, clear cut, non-fading color reaction given by the tolidin as compared to the transitory and often difficult to read reactions of benzidine when the amount of blood present was small.

TABLE I
Subject No. 1; Experiment No. 1

Benzidine Reagent:						
Direct application to stool	0	0	0	0	0	+
Ring test with ether extract	0	0	0	+	+	++
Tolidin Reagent:						
Direct application to stool	0	0	+	+	+	++
Ring test with ether extract	0	+	+	++	++	++
Spectroscopic test for hematoporphyrin	0	0	+	++	++	++
C.c. of blood ingested per day	0	1	2	3	4	5

This experiment indicates that the most sensitive method is the ring test using tolidin reagent and an ether extract of acidified stool. This test can detect 1 c.c. of blood per day while 2 c.c. of blood per day can be detected by the direct application of tolidin reagent to the stool while 5 c.c. of blood per day is necessary to give a positive reaction when benzidine reagent is applied directly to the feces.

TABLE II
Subject No. 1; Experiment No. 2

Benzidine Reagent:					
Direct application to stool	0	0	0	0	+
Ring test with ether extract	0	+	0	+	++
Tolidin Reagent:					
Direct application to stool	0	0	0	0	++
Ring test with ether extract	0	++	0	++	++
Spectroscopic test for hematoporphyrin	0	0	+	+	++
C.c. of blood ingested per day	0	1	2	3	5

The second experiment on subject No. 1 confirmed the findings of the first experiment except that the direct application of tolidin reagent to the stool did not give a positive reaction when the rate of blood ingestion was 3 c.c. per day.

TABLE III
Subject No. 2

Benzidine Reagent:							
Direct application to stool	0	0	0	0	0	0	0
Ring test with ether extract	0	0	+	++	++	++	++
Tolidin Reagent:							
Direct application to stool	0	0	0	0	0	0	++
Ring test with ether extract	0	+	+	++	++	++	++
Spectroscopic test for hematoporphyrin	0	0	0	0	0	+	+
C.c. of blood ingested per day	0	0.9	1.1	1.5	2.5	3.0	4.5

These results indicate that the tolidin reagent is more sensitive than the benzidine reagent. Three c.c. of blood per day were necessary to give a positive hematoporphyrin test while 2 c.c. were sufficient in subject No. 1.

The ring test in which the reagent is layered beneath an ether extract of acidified stool proved to be an exceedingly sensitive test, particularly when the tolidin reagent was used. Amounts of blood as small as 1 c.c. per day (0.33 c.c. three times a day) were found to be detectable by this method. For routine clinical use, however, the stools can be satisfactorily examined by the direct application of the reagents to the solid feces. The ring tests may be reserved for particular cases when very minute quantities of blood are to be detected and the spectroscopic test for cases in which blood has been found by the tolidin test and it is necessary to establish the level of bleeding in the gastrointestinal tract.

The sensitivity of the spectroscopic test for hematoporphyrin was found to be well within the range of clinical usefulness. Tables I, II and III, show that this test became positive when 3 c.c. of blood were ingested daily. It is particularly valuable in determining if there is bleeding in the upper intestinal tract in patients who have persistent contamination of their stools with fresh blood from anal lesions.

The proper interpretation of positive tests requires considerable care. In the first place the diet should be entirely free of meat and fish for three or four days. Charcoal or carmine may be used to mark the stools at the point at which meat was eliminated. Green vegetables should also be eliminated from the diet when hematoporphyrin is to be tested for, because chlorophyl gives rise to confusing bands in the spectrum. Carmine is also unsatisfactory as a marker when the spectroscopic test is to be used. It is very important to recognize any bleeding in the mouth or nasopharynx of patients being tested for gastrointestinal bleeding, since blood from this source cannot be differentiated by any test on the stools. Many patients have such persistent bleeding from the gums that tests for occult blood in the stools are totally worthless. In some cases this source may be eliminated by having the patient use a piece of gauze instead of a tooth brush to clean the teeth. The gauze tends to absorb any blood liberated during the process. It should also be remembered that the passage of a stomach tube may cause sufficient bleeding to give temporary positive tests for blood in the stools. Bleeding from benign lesions in the anal canal, such as hemorrhoids and anal fissures, often give rise to insignificant positive tests. This may be reduced to a minimum by the use of rectal instillations of oil to keep the stools soft. Formed stools can often be satisfactorily tested by cutting the stool with a knife and applying the reagent to the inside cut surface. Blood from this source does not interfere with the test for hematoporphyrin.

The value of any test frequently depends upon its adaptability to use by technicians in a hospital laboratory. During the past year the stools of all our patients under gastrointestinal observation and treatment at the New England Deaconess Hospital, have been tested by both the benzidine and the tolidin reagents. The technicians doing the test report that the tolidin reagent gives a much sharper and more clear-cut reaction and is frequently positive when the benzidine reaction is negative.

Although our experience with this test covers a large number of stool examinations, the results in a comparatively small group of representative cases are reported as follows: There were examined 95 stools from 25 patients who were on a meat free diet and who had no gastrointestinal lesion, or any other source of gastrointestinal bleeding. The benzidine reaction was negative in 95 stools and positive in none. The tolidin reaction was negative in 92 stools and positive in 3. In 15 of these 25 cases the stools were examined after meat had been added to the diet. There were 76 stool specimens upon which the benzidine reagent gave a negative reaction in 62 and positive in 14, while the tolidin reagent gave a negative reaction in 14 and positive in 62.

There were in all 39 cases who were on a diet containing more or less meat, fish or chicken, and who had no known lesion or source of blood in the gastrointestinal tract. Upon this group there were 244 stool examinations. The benzidine reaction was negative in 196, positive in 48. The tolidin reaction was negative in 43, and positive in 201.

The results with the above two groups of patients show that the tolidin reagent is much more sensitive to meat in the diet than is the benzidine reagent. They also show that if meat is rigidly excluded from the diet, the tolidin reagent does not give false positive results.

There were 14 cases of peptic ulcer who were on a meat free diet and upon whom there were 190 stool examinations. These patients were on medical treatment and in many instances the stools became negative for occult blood both by the benzidine and tolidin reactions. It was frequently noted that on admission the stools would be positive both to the benzidine and tolidin reagents. In a few days on treatment the benzidine reaction would become negative and a few days later the

tolidin reaction would also become negative, indicating that in a slowly diminishing amount of bleeding the more sensitive test became negative last. In the 190 stool examinations the benzidine reaction was negative in 161, and positive in 29. The tolidin reaction was negative in 85, and positive in 105. The results in this group show that the tolidin reagent is capable of detecting bleeding from peptic ulcers which are too small to be detectable by the benzidine reagent.

Our experience with these tests has demonstrated that the application of both tests to each stool has definite clinical value since it makes possible a rough estimate of the amount of occult blood present. This fact is more definitely demonstrated by individual cases.

Case I. Clinic No. 20689, female, aged fifty. There was a history of stomach trouble for many years. The *x*-rays showed a small lesion of the lesser curvature of the stomach. While the patient was under observation in the hospital she was on a meat-free diet. There was no evidence of any oral or rectal bleeding. Five stools were examined by the benzidine and the tolidin methods. The benzidine test was consistently negative while all five stools were strongly positive to tolidin. The patient was operated upon and a small unhealed ulcer was found in the lesser curvature of the stomach.

Case II. Clinic No. 29190, male, aged forty-nine. The history was typical of duodenal ulcer for six years with recent activity. *X*-rays showed a defective duodenal cap. The diet was meat free and there was no evidence of any oral or rectal bleeding. The diminution of the amount of blood in the stools is shown by the application of both tests to the stools.

Date	Benzidine	Tolidin
Aug. 14	o	+
16	o	+
16	+	+
19	+	+
20	+	+
22	+	+
23	o	o
25	o	+
25	o	+
26	o	o
27	o	o
28	o	+
28	o	o
29	o	+

Case III. Clinic No. 29455, male, aged sixty. This patient entered the hospital soon after a massive, gross hemorrhage from the gastrointestinal tract. *X*-rays showed a typical duodenal lesion and the patient eventually recovered entirely on ulcer management. There was no evidence of any oral or rectal bleeding, the diet was meat free. The following record of the stool examinations show that the tolidin test is more sensitive in detecting small amounts of blood from the active duodenal ulcer:

Date	Benzidine	Tolidin
Aug. 30	+	+
Sept. 1	o	+
2	o	+
2	o	o
3	o	o
5	o	+
6	o	+
7	o	+
8	o	o

Case IV. Clinic No. 33810, female, aged sixty-four. This patient had stomach symptoms for one year. *X*-ray examination showed a lesion on the lesser curvature of the stomach. There was no evidence of rectal or oral bleeding. The patient was in the hospital in bed on a meat free diet. All the stools were examined for occult blood. At first the benzidine test was definitely positive, but later became negative. The application of the tolidin test to the same stool which gave a negative benzidine test showed a strongly positive test to tolidin. The hematoporphyrin test was also positive. At operation a carcinoma of the stomach was found.

Case V. Clinic No. 35103, female, aged forty. She gave a history of diarrhea of seven months' duration. The stools were watery, but no blood had been noticed. She was anemic. Rectal examination disclosed a carcinoma of the rectum. In spite of this, seven of ten stool examinations were negative by the benzidine test while all ten were positive by the tolidin test.

SUMMARY

Attention has been called to some of the advantages of tolidin as a reagent for testing feces for occult blood.

Experimental evidence has been presented showing that a daily ingestion of at least 5 c.c. of blood divided in three equal doses with meals is necessary to give a positive test for occult blood in the stools when the benzidine reagent is used. When tolidin reagent is used from 2 to 4.5 c.c. of blood could be detected. The spectroscopic test for hematoporphyrin became positive when 3 c.c. of blood were added to the food.

Clinical comparison of these tests show that the benzidine reaction is frequently negative when the subject is on a diet containing meat, but the tolidin test is nearly always positive; that the tolidin test does not give false positive tests when meat is excluded from the diet and there is no bleeding into the gastrointestinal tract; and that the tolidin reaction is more frequently positive when there is an ulcerative lesion in the stomach or intestines than is the benzidine reaction.

The spectroscopic test is useful in determining the level of the source of occult blood in the feces.

A dual test in which both the benzidine and tolidin reagents are used is recommended.

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CASE REPORTS

APPENDICO-VESICAL FISTULA*

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FISTULOUS communications between the vermiform appendix and the urinary bladder occur but rarely. Fistulae between other portions of the intestinal tract and the bladder are much more frequently seen but even these are uncommon.

The mobility and length of the appendix undoubtedly plays an important etiological role. It is of interest that two of the reported cases[1,2] had pins recovered from the bladder prior to the onset of symptoms characteristic of enterovesical fistula. Pilcher's patient[3] was found to have a small stone in the bladder at the time of operation. Others[4,5,6] have followed acute appendicitis.

The symptoms of severe bladder irritation and pneumaturia with passage of fecal particles in the urine are common to all entero-vesical fistulae, regardless of the location. In appendico-vesical fistula these symptoms may be intermittent.

CASE REPORTS

CASE I. U. M. 170216, female, thirteen years of age. Admitted to the University Hospital with the complaint of persistent diarrhea, burning and smarting on urination and pain in the lower abdomen. These symptoms had been constantly present for ten years, at times becoming very severe. Ten years prior to admission patient had had an operation at which time a large bladder stone was removed. Imbedded in the stone was a pin (Fig. 1). Following this operation her symptoms persisted. A subsequent operation upon the bladder failed to clear up her symptoms. Just what was done at this second operation is not known. During the last three years prior to her admission she had progressive increase of all her symptoms, recently noting the passage of small fecal particles from the bladder upon urination. No history of pneumaturia.

Physical examination revealed a poorly developed and undernourished girl. There was rather marked tenderness throughout the lower abdomen. Scars from her former operations were noted. Cystoscopic examination showed the left ureter to be a bit obscured by the diffuse mucosal inflammation that was present in the bladder. There were found three depressions where the right ureter should have been, but catheterization was impossible in any of these depressions. With the bladder filled to capacity some of the distending medium escaped into the intestine and was expelled from the rectum. Rectal examination failed to show any area of induration within reach of the finger. Cystographic studies revealed nothing. The urine was loaded with white and red cells and many cocci and bacilli.

At operation, a lower abdominal incision was made and the tip of the appendix found to be adherent to the vesicouterine fold and was obviously the site of communication. The appendix was removed from its base downward and its tip then buried into the bladder wall. The abdominal wound was closed without drainage and the bladder drained by urethral catheter for twelve days postoperative.

The patient was discharged from the hospital on the fourteenth postoperative day and was entirely free from symptoms at that time.

CASE II. U. M. 189794, male, thirty-three years of age. Entered the University Hospital

* From the Department of Surgery, University of Michigan.

October 12, 1933 complaining of severe dysuria, constant burning in the urethra, frequency, pneumaturia, and gross fecal material in the

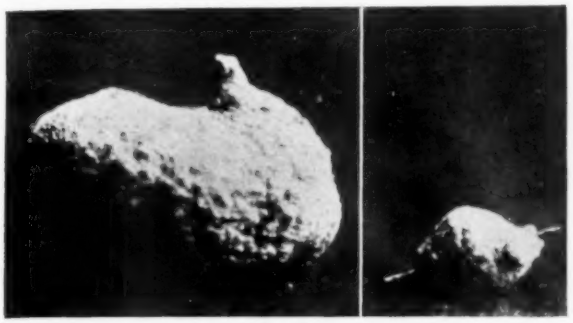

Fig. 1.

urine. Symptoms were of two days' duration. Diarrhea for one day prior to admission.

Past History (genito-urinary tract): In 1910 at the age of ten he developed painful urination with burning at the meatus. This continued off and on for ten years. Since 1920 he has had infrequent attacks of dysuria with occasional attacks of chills and fever with right costovertebral tenderness. In 1928 a complete urological examination was made, ruling out tuberculosis. At that time no infection was found in the upper urinary tract and a diagnosis of chronic prostatitis and seminal vesiculitis was made. He passed a small stone from the bladder in October, 1932.

Examination: Physical examination was negative throughout except for definite suprapubic tenderness. The prostate was very tender. The urine had a fecal odor. On microscopic examination vegetable fibers were seen in the sediment.

Cystoscopic examination revealed a definite fistulous opening on the floor of the bladder just medial to the right ureter orifice. No attempt was made to pass a catheter into this opening, due to discomfort of the patient. Intravenous pyelograms were negative. Cystograms were negative except for a slight extravesical increased density in the region of the cecum.

Barium enema revealed the following: "Barium is easily injected into the colon without incident until barium column reaches the hepatic flexure. No opaque media can be forced into cecum which is apparently filled with clear fluid. Upon micturition with screen control, barium is seen to enter the cecum as clear fluid leaves. No barium in the urine at this time. After barium flows into a long irregular appendix and the terminal small bowel, extension of the opaque media through the lumen of the appendix into the bladder is observed.

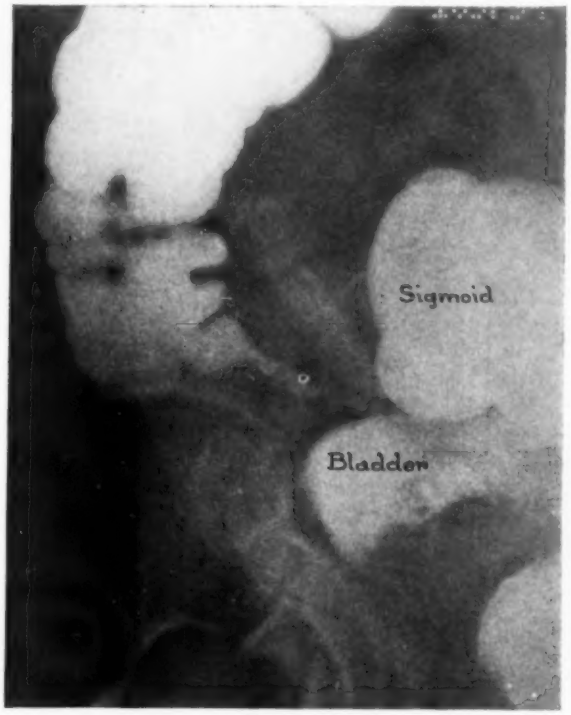

Fig. 2.

Upon micturition now, almost clear barium suspension is recovered. Films made during screen examination show satisfactory filling of

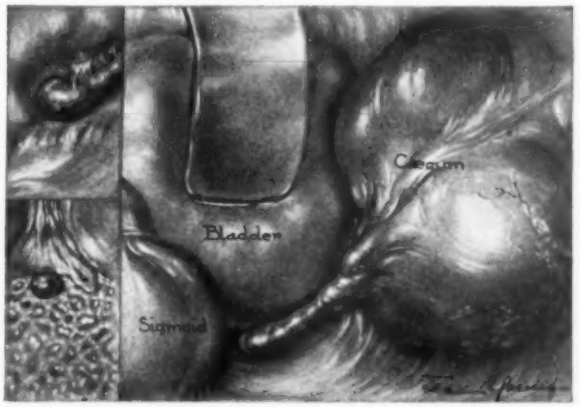

Fig. 3. Upper left. Detail attachment of appendix to base of bladder seen by abdomen. Lower left. Detail appendico-vesical fistula seen by suprapubic opening. Small appendolith seen at opening of fistula medial to right ureter orifice.

the entire colon, and visualization of a long, somewhat irregular appendix communicating with the bladder near its floor." (Fig. 2.) Therefore a diagnosis of an appendico-vesical fistula was made and operation advised.

Operation. A midline lower abdominal incision was made. The appendix was 7 cm. long. Its bulbous tip was adherent to the base of the bladder just medial to the right ureter. The tip of the appendix was dissected from the bladder and an appendectomy done. The bladder was closed with three lines of catgut sutures. The bladder was opened at its fundus and a fecalith 1 × 0.5 cm. in size removed. The bladder was drained suprapubically.

Postoperative convalescence was uneventful, the patient leaving the hospital on the twenty-first postoperative day.

The cases here reported each have unusual features which render them of particular interest. Case 1 is the third reported in the literature resulting from the passage of a pin from the appendix into the bladder. Case 2 is the first reported case of appendico-vesical fistula in which the preoperative diagnosis was established by means of the barium enema and the roentgen ray. The ease with which the diagnosis was established by *x*-ray in this case would recommend its utilization in all suspected cases. The fluoroscopic technique employed by Dr. F. J. Hodges in this case is particularly noteworthy.

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SUMMARY OF DR. KENNEDY*

At the Joseph Price Hospital we use through-and-through sutures of silkworm gut; the only buried sutures we ever use are silk sutures in incisional ventral and umbilical hernias where there has been wide separation of tissues and occasionally in a very stout woman with abnormally thick abdominal walls.

In fifty-six years' experience Dr. Joseph Price and I have had no case of disruption of the abdominal wound nor any death from an infected abdominal incision. The through-and-through suture is void of causing any molecular death in the incisional surface and is a drainage suture. It is preeminently void of all unnecessary trauma.

During the last fifteen years at this hospital there has been no closure of an undrained incisional hernia; possibly some unknown hernias exist.

The technique depends upon proper insertion of the through-and-through suture. We use the long straight abdominal needle. The correct method is illustrated.

*Continued from 520.

CONGENITAL APLASIA OF COSTAL CARTILAGES*

J. K. Colman, M.D., and J. Dewey Bisgard, M.D.

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THE rare occurrence of congenital absence of one or more costal cartilages as an entity unassociated with other primary congenital defects of the thorax leads the authors to report an illustrative case which was recently studied at the University Hospital. This malformation not only produced a large depression of the anterior thoracic wall which moved directly with each cardiac cycle and paradoxically with respiration, but also was associated with certain secondary changes in the ribs, spinal column and shoulder girdle. A detailed description of the deformity is presented in the case history.

Descriptions of only 11 similar cases could be found in an extensive review of the literature and data from these have been compiled for comparison in Table 1. The first of these cases was reported by Lallemond[1] in 1826. His patient, a man, had a depression "as big as a fist" in the left thorax, caused by absence of the third, fourth and fifth cartilages on that side. To this anomaly Lallemond applied the term "transverse thoracic fissure."

To be differentiated from this particular type of deformity (absence of cartilages only) are the commoner anomalies which involve not only the cartilages but also the ribs or the ribs alone. These malformations may be unassociated with other primary developmental disturbances as in our case of aplasia of cartilages, or they may occur in conjunction with congenital deformities of the vertebrae of the dorsal column. Another group of anomalies which deserves mention includes those bizarre malformations of ribs which show not only arrest of development but also fusion and bifid formation. Illustrative cases have been described by Cruveillier,[2] Struthers,[3] Clerc, Didier and Bobrie,[4] and Savès and Barge.[5]

Grèpat[6] is credited with the first report of congenital absence of both the ribs and their cartilages. In 1872 he described an acephalic monster with only nine ribs on the right and seven on the left side. Since then there have been innumerable case reports of similar deformities of the thorax. These defects were almost always unilateral and usually involved the left side and one or more of the sixth to the tenth ribs. In many of the cases there were varying degrees of herniation of the lung, spleen and stomach. Frequently there were associated congenital deformities of the head or extremities. For detailed descriptions of some of these cases the reader is referred to the manuscripts of Packard,[7] Murray,[8] Young,[9] Gage,[10] Sabrazès,[11] Freund[12] and Smith.[13]

Some idea of the incidence of anomalies of ribs and cartilages in general may be obtained from a study reported by White.[14] He found evidence of costal abnormalities in only 1 per cent of routine roentgenograms of the thorax of 5728 patients, and observed that supernumerary ribs (principally cervical) constituted the most common abnormality. No mention is made of absence of ribs.

In an excellent review of the entire subject Smith[13] points out that arrest of development of ribs and cartilages both is more frequently met with than complete absence, and that these arrests usually occur in the cartilages and the anterior portion of the ribs. Judging from the cases compiled in Table 1, aplasia of cartilages

* From the Department of Surgery, University of Michigan.

occurs more frequently on the right side, where it occurred in 8 of the 12 cases. It should be noted that all the patients were males.

CASE REPORT

R. A. (Figs. 1 and 2). A man of twenty-six years entered the University Hospital complaining of recurring dislocation of the left shoulder. Following the onset one year previously the shoulder had dislocated simply with extreme external rotation of the arm on eight occasions, twice during epileptic seizures to which he had been subject since the age of nineteen.

He also sought advice concerning a large depression of the left anterior thoracic wall which he stated had been present since birth, but at no time had caused subjective symptoms. There was no familial history of similar or other congenital deformities.

The physical examination was essentially negative, except for the deformity of the thorax. This consisted of a triangular depression measuring 6 × 6 × 4 cm. in the left anterior thoracic wall. The upper border was formed by the second rib and its cartilage, the base by the free anterior ends of the third, fourth, and fifth ribs at the anterior axillary line, and the lower margin by the sixth costal cartilage. (Fig. 1 A.)

TABLE 1
APLASIA OF COSTAL CARTILAGES

Author	*Sex*	*Age*	*Side*	*Aplastic Costal Cartilages*	*Scoliosis*	*X-rays*	*Postmortem Observations*	*Muscles*	*Associated Deformities*	*Position of Heart*
1. Lallemond...	M	Adult	Left	3–4–5	0	0	0	No mention	No mention	Dextrocardia
2. Vielle.....	M	45	Right	3–4	0	0	+	Pectoralis major and minor atrophied	No mention	Normal
3. Reverdin....	M	Infant	Right	3–4	0	0	+	Pectoralis major and minor absent	No mention	Normal
4. Osborne.....	M	13	Left	2–3–4–5	0	0	0	No mention	No mention	Dextrocardia
5. Sabrazès.....	M	5	Right	2–3–4	Right	0	0	Both pectorals undeveloped	Bifid xyphoid—right nipple absent	Normal
6. Levy.....	M	13	Right	3–4	Right	0	0	Only clavicular portion of pectoralis major	No mention	Normal
7. Jefferiss.....	M	12	Right	3–4	Right	0	0	Pectoralis major absent, minor small, deltoid over developed	Nipple absent	Normal
8. Apert and Buc.	M	.....	Right	3–4	Right	0	0	Absence of inferior portion of pectoralis major	Femoral and tibial exostoses, nipple small	Normal
9. Benians and Jones.	M	1	Right	1–2–3–4–5	0	0	+	Normal or overdeveloped	Right nipple small and displaced, rickets, undescended testis, incomplete division of lungs into lobes	Normal
10. Schiavone...	M	4	Left	2–3–4	Left	+	0	Atrophy of inferior portion of pectoralis major	Rickets, undescended testicle, left nipple displaced	Dextrocardia
11. Lereboullet, Bohn and Worms.	M	12	Right	3–4–5	0	+	0	Absence of pectoralis major	Absence of nipple, atrophy of right arm, syndactylism, precocious puberty, mental retardation	Normal
12. Colman and Bisgard.	M	26	Left	2–3–4–5	Left	+	0	Atrophy of inferior portion of pectoralis major	Recurrent dislocation left shoulder, epilepsy	Dextrocardia

Within the boundaries of this defect the thoracic wall felt firm but pliable and obviously contained no palpable bone or cartilage. It normally rounded. There was a slight high dorsal sinister-convex scoliosis with slight inclination of the head to the right. (Fig. 1 B.)

A B

Fig. 1. Case 1. Congenital aplasia of the left third, fourth and fifth costal cartilages.
A. Note triangular depression of left anterior thoracic wall, displaced areola, absence of inferior portion of pectoral muscles and elevated shoulder on that side.
B. Posterior view to show sinister-convex scoliosis and high prominent left scapula.

retracted and bulged with each cardiac cycle and moved paradoxically to a slight degree with respiration. The left anterolateral border of the heart was distinctly palpable. The right border of cardiac dullness was 3 to 4 cm. to the right of the sternum. The skin over the defect was normal in appearance and there were no cicatrices. The left nipple was absent and there remained only a small round slightly pigmented areola. The left pectoral muscles were approximately one-third their normal size due to absence or atrophy of the lower digitations. Consequently the anterior axillary fold was somewhat higher and thinner than that of the right side. The axillary hair was found displaced downward on the arm to approximately the junction of the upper and middle thirds. The left clavicle assumed a position more superior and posterior than its fellow as did the entire shoulder girdle. The left scapula was abnormally prominent and its angle ab-

Motions of the left shoulder joint were slightly limited in all directions and there appeared to be moderate thickening of the periarticular tissues.

The routine laboratory studies of the urine and blood, including the blood Kahn reaction, showed no abnormalities.

The roentgenological examination showed underdevelopment of the left third, fourth and fifth ribs, especially anteriorly, with overdevelopment of the gladiolus sterni. The second rib had a very much elongated cartilage which appeared not to join the sternum. The first and fourth intercostal spaces were widened and the second and third were abnormally narrow.

There was a slight deviation of the upper dorsal spine to the left and slight wedging of the fifth dorsal vertebra. The heart shadow was normal except for moderate but definite displacement to the right (Fig. 2).

On January 25, 1933 the left shoulder was operated upon for radical cure of recurring dislocations, using the tendon suspension operation described by Henderson.

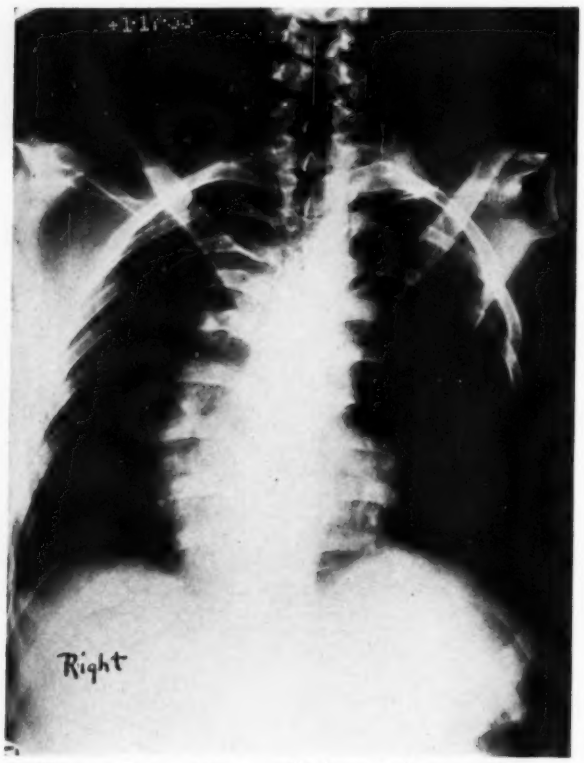

FIG. 2. Case 1. Note scoliosis and dextrocardia.

No treatment was given to the deformity of the anterior thoracic wall.

COMMENT

This case illustrates a particular type of deformity which has been designated as congenital aplasia of costal cartilages. It appears that the fundamental defect which causes the deformity is a local disturbance of fetal chondrogenesis. The deformities of the ribs, muscles, shoulder girdle and spine probably develop secondarily to the alteration of function and the lack of support resulting from the absence of cartilages.

To explain this disturbance several theories have been advanced. Sappey[15] and Sabrazès[11] attribute the deformities to arrest of development but assign no cause for this arrestment. Thomson[16] points out that they do not represent arrests in the same sense as do mesial fissures of the thorax and abdomen because they have no analogy in the normal course of evolution. He conjectures that they are produced by pressure of the hand and arm against the thorax during intrauterine life and that "not only was the growth of the parts retarded but absorption of some of them was brought about." These views are also held by Benians and Jones[17] and Marfan and Apert,[18] and they believe that abnormal pressure is exerted upon the parts by a deficiency of amniotic fluid. Fabris[19] considers the possibility of distorted intrauterine relations and abnormal pressure from tumors of the gravid uterus, and Ahlfeld[20] suggests that amniotic bands may play a part in some cases. Fetal rickets has been considered as an etiological factor and congenital syphilis has been suggested by Schiavone.[21]

It is possible that the theory of localized pressure may account for the thoracic deformities but it fails to explain the deformities of parts remote from the thorax in cases in which both occur. It seems likely that the same factors which are productive of deformities in general are responsible for aplasia of cartilages. Experimental studies indicate that these factors may be inherent in the original chromosomes or may develop during early fetal life as a result of chemical, physiochemical, nutritional and other general disturbances.

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[For Remainder of References see p. 550.]

FIBROBLASTIC SARCOMA OF THE STOMACH

D. B. FREEMAN, M.D., F.A.C.S.

MOLINE, ILL.

SINCE sarcoma of the stomach is relatively of rare occurrence, a proved case may be of interest to every surgeon and clinician. It is for this reason that the following case is reported. It is not the intent of this paper to give a complete review of the literature on this subject but merely to reiterate a few salient points of interest and to draw some conclusions relative to this condition. Points of interest in this case are:

1. The relative slight pain compared to the size of the mass.
2. The amount of involvement necessitating gastrectomy and resection of all the transverse colon.
3. The mobility: on examination the mass was very mobile resembling an enlarged spleen.
4. Lack of symptoms of retention or obstruction at the pylorus.
5. The patient having no definite symptoms until the discovery of the mass on receiving a slight injury in the region of the stomach.
6. The growth originating from the wall of the stomach, submucous or subserous, then growing between the layers of the gastrocolic omentum, infiltrating into the wall of the colon.
7. The slight amount of weakness in relation to the anemia, the patient being able to work up to the time of operation.
8. Absence of bloody stools or gastric hemorrhage.

Case No. 31620. Lutheran Hospital.

H. E. M., a white male, American, aged sixty-one, a mechanic by trade, entered the hospital October 14, 1933.

Entrance Complaint: Mass in upper part of abdomen.

Family History: His father died of carcinoma of bladder at eighty-seven. His mother died during childbirth at the age of twenty-nine. On careful questioning there was no other history of carcinoma or sarcoma except that of his father, no history of tuberculosis, diabetes or nephritis. Habits were good. He smoked cigarettes moderately, used alcoholic beverages moderately, coffee and tea moderately.

Previous History: He was never seriously ill during childhood. He had no illness until 1927 when he consulted a physician on account of a stomach ailment. At that time a fluoroscopic and *x*-ray examination of the stomach was made with negative findings. No definite diagnosis was made but he was given some medication with relief. In 1928, he had a recurrence of symptoms similar to those of the previous attack, went back to the same physician and again was relieved by medication. At no time was there any diarrhea or constipation. He did not pass any blood at any time. There was no history of any urinary disturbance, no backache or headache. Since 1928 he had had several attacks of vomiting but felt relieved as soon as the stomach was empty. These attacks were very infrequent in the past two years, in fact has felt very well until the present illness.

Present Illness: Six weeks before entering hospital, following a slight injury to the left side of the abdomen, he discovered a mass to the left and above the umbilicus about the size of a cocoanut. On palpation the mass was tender. He had had no pain previous to this discovery of the mass. He continued working as much as his duties called him until a few days before entrance to the hospital, when he noticed an increase in the size of the growth and the pain was becoming more marked. He had lost 9 pounds during this time. He did not have any marked gastric disturbance, very little nausea or vomiting, his appetite was good, bowels regular.

Physical Examination: Examination at the time of entrance into the hospital revealed the following: Nutrition and development fair, shows some loss in weight, actual weight being 126 pounds, normal weight being 135 pounds. He was somewhat pale and anemic. Temperature 99.8°F. Head and neck negative,

heart regular, rapidity 80, no murmur, no enlargement, apex beat 5th interspace. Lungs clear, no râles, no areas of dullness. Abdomen dry. Extremities normal and reflexes normal. Blood pressure, 100 S., 70 D. Urinalysis: yellow, sp. gr. 1.017, no sugar, no albumin, no

Fig. 1.

Fig. 2.

Figs. 1 and 2. Gross specimen. A, B, C. Stomach. D, E, F. Transverse colon.

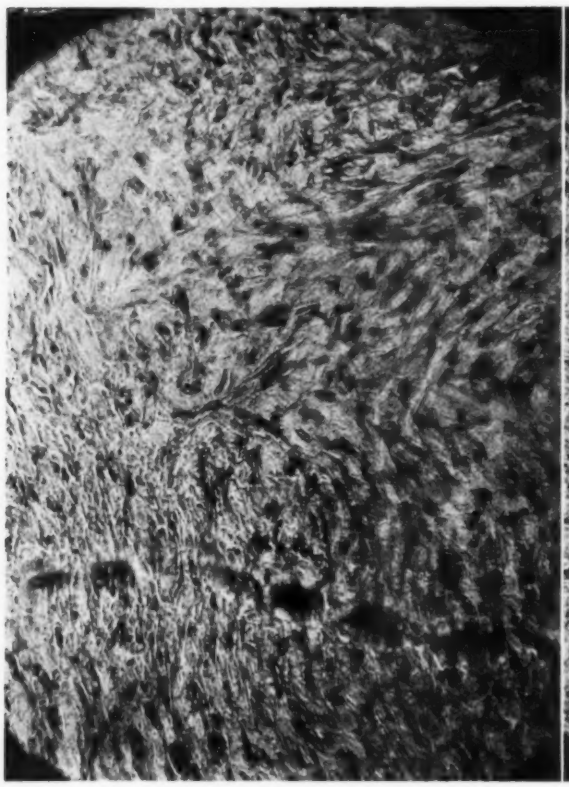

Fig. 3.

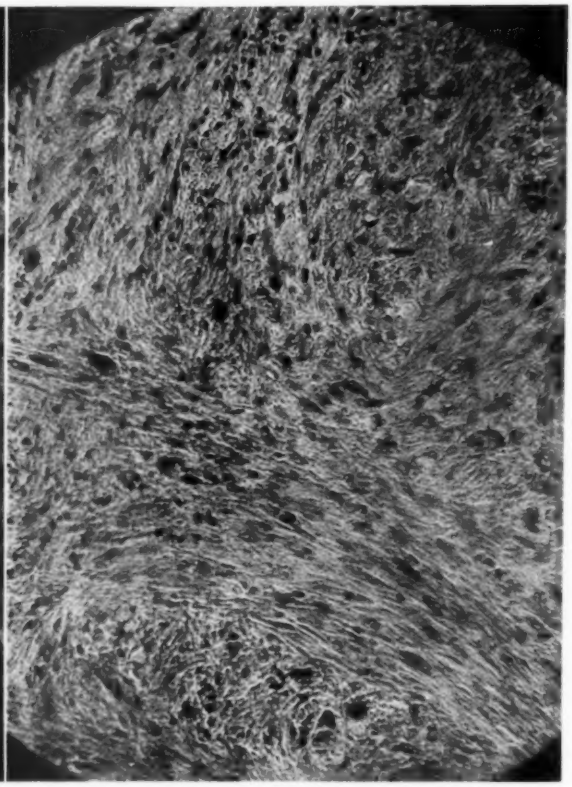

Fig. 4.

shows some loss in weight, slightly scaphoid, with a mass showing prominently above and to the left of the umbilicus. This was larger and longer than a cocoanut, movable, nodular and hard. Palpation of growth caused some pain, it was tender to touch, not adherent to the anterior abdominal wall and seemed to move backward into the region of the spleen, resembling enlarged spleen. Skin somewhat blood. Blood: red cells 3,200,000; white cells 13,000, hemoglobin 39 per cent.

Operation: The usual preparations for laparotomy were carried out. A left rectus incision was made and the abdomen opened from near the ensiform to below umbilicus. A mass larger than a cocoanut, somewhat elongated, involving the greater curvature of the stomach and the transverse colon, was found. It was

encapsulated between the layers of the gastrocolic omentum, hard, nodular. Much serous fluid was present in the abdominal cavity. The transverse colon was resected, an end-to-end anastomosis was done between the ascending and the descending colon, and then a gastrectomy of approximately two-thirds or more of the stomach was performed. All bleeding points were ligated and rough areas covered with serosa, the mass being removed in toto. The abdomen was closed without drainage. He was given normal saline hypodermoclysis on the table and returned to bed.

Subsequent Course. The patient showed very little shock or ill effects following operation. Temperature up to 101.4°F. was the high point. The pulse reached 100 just after operation. The temperature, respiration and pulse reached normal about the fourth day and remained there during the entire stay at the hospital. At no time did he vomit and at no time did he have any pain severe enough to require an opiate. The patient left the hospital on the fifteenth day, wound healed and condition good. Subsequently he has continued to improve.

Macroscopic Findings: A large mass somewhat larger and longer than a cocoanut and elongated about 8 to 9 inches in length and 6 inches in diameter, somewhat encapsulated and nodular. Actual weight 994 gm., length 9 in., diameter 6 in. It took origin from the greater curvature of the stomach submucous or subserous layer and penetrated between the two layers of the gastrocolic omentum. The greater curvature for about two-thirds of the stomach and the transverse colon were adherent or the mass was grown into the wall of the transverse colon. All this was in the well-defined nodular mass. (Figs. 1 and 2.)

Microscopic Findings: Fibroblastic sarcoma of stomach wall. (Figs. 3 and 4.)

POINTS TO BE CONSIDERED IN SARCOMA OF THE STOMACH

1. No positive diagnosis can usually be made preoperative.

2. The diagnosis of carcinoma is excluded by the absence of symptoms of carcinoma, such as much loss in weight, weakness, gastric hemorrhage, signs of obstruction of the pylorus, etc.

3. The diagnosis of sarcoma is usually made by exploratory laparotomy or postmortem.

Sarcoma of the stomach arises from:

1. Connective tissue, when it is a true fibrosarcoma.

2. From the smooth muscle cells of the wall of the stomach, when it is a leiomyosarcoma or malignant leiomyoblastoma.

3. From the lymphoid nodules, when it is a malignant lymphoblastoma, following Mallory's classification (lymphosarcoma, Hodgkin's disease).

4. From endothelial cells of blood vessels or lymph channels when an endothelioma, or hemangioendothelioblastoma results.

There are four types of tumor of the stomach which are non-epithelial, yet malignant in their progress:

1. Leiomyosarcoma
2. Fibrosarcoma
3. Lymphoblastoma
   Lymphosarcoma
   Scirrhous type, Hodgkin's disease
4. Endothelioma.

CONCLUSION

1. From a review of the literature on gastric sarcoma it is evident that this condition is very rare. Recovery from this condition likewise is infrequent.

2. Due to the origin of sarcoma in the submucous layers and tissues of the stomach wall other than the mucous lining, sarcoma causes few distinct or pathognomonic symptoms.

3. Sarcoma can involve a considerable area of the stomach and neighboring organs such as the transverse colon without causing marked symptoms until late.

4. On careful study and examination it would be possible to make a preoperative diagnosis of sarcoma of the stomach and differentiate from carcinoma by exclusion or absence of symptoms of carcinoma.

5. Gastrectomy, resection and complete removal of sarcoma should be the operative choice rather than palliative procedures.

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SOLITARY ADENOMATOUS POLYP OF CECUM*

ASSOCIATED WITH RECURRENT INTUSSUSCEPTION*

LON GROVE, M.D. AND JOSEPH C. READ, M.D.

ATLANTA, GA.

THE rather rare occurrence of solitary adenomatous polyps of the cecum associated with recurrent intussusception justifies the report of this unusual case.

King,[1] in a very exhaustive review of the literature in 1917, found 119 cases of benign tumors of the intestine, 17 of which were adenomatous polyps. Among these 17 cases there were 12 in which the tumor was in the large bowel but only one showed a tumor in the cecum and this was associated with multiple polyposis of the entire bowel. Saint[2] studied 44 cases of adenomatous polyp, only 9 of which were located in the cecum and all of these were associated with polyps elsewhere in the colon. Fitzgibbon and Rankin[3] reported 13 cases of polyposis of the colon and only showed a cecal polyp. Rohrbach[4] reported a case of diffuse polyposis of the colon associated with ileocecal intussusception in which the colon was resected. Koster[5] reported 5 cases of intussusception associated with intestinal polyposis, only one of which was cecal, and one of the ileocecal region. In the former case a colon resection was performed; in the latter a simple excision of the tumor mass. Buie and Swan,[6] from 1924 to 1928, performed over 19,000 proctoscopic and sigmoidoscopic examinations and only 2.38 per cent showed polyps in the large bowel. They reported 52 benign colonic growths from the Mayo Clinic from 1905 to 1926 and of these there were 19 adenomatous growths. Of these only 3 occurred in the right half of the colon. Ewing[7] referred to Thorbecke's report of 34 cases of polyposis of which 23 were in the rectum, 5 in the colon and rectum and 6 in the colon alone. Ewing states that the "common pedunculated adenomas occur throughout the intestinal tract, chiefly in the rectum and colon." In this case we believe the polyp was solitary since there were no other polyps in the resected specimen and the preoperative barium enema showed none.

CASE HISTORY

H. H., aged five years, was admitted to Eggleston Memorial Hospital, June 27, 1933, complaining of abdominal pain and diarrhea. In infancy, the patient was habitually constipated and at five months of age had an attack of nausea, vomiting, complete obstipation for four days, and a mass in the right lower quadrant. X-rays were reported negative. For two years there had been frequent vomiting associated with constipation, relieved by enemas and cathartics.

During the two weeks before admission the patient had recurring attacks of vomiting, profuse diarrhea with large blood clots, generalized crampy abdominal pain, and a recurrence of the abdominal mass. The day before admission, the patient awoke screaming with severe, cramp-like, generalized abdominal pain, which persisted in spite of opiates, and a barium enema showed an abnormality of the right colon.

Examination showed an acutely ill white girl with flushed cheeks, dry skin, and a pulse of 140. There was moderate distention with tympany over the entire abdomen with generalized rigidity and tenderness, more marked in the right half. There was a movable, tender, sausage-shaped mass which extended from the mid-point of the ascending colon to the splenic flexure. The preoperative diagnosis was recurrent intussusception.

At operation, the intussusception consisted of 2 feet of small bowel and the cecum, in-

* Read before the Fulton County Medical Society.

vaginated almost to the splenic flexure. The intussusception was easily reduced but a rounded mass, 4 cm. in diameter, remained in the cecum, attached by a rather broad base to the mesenteric side of the cecum near the ileocecal valve. It almost occluded the cecal lumen.

Fig. 1. Preoperative filling defect in right half of colon due to intussusception.

After reducing the intussusception the cecum and approximately two-thirds of the ascending colon were resected and a lateral ileo-transverse colostomy performed. A primary ileostomy was performed through the left lower quadrant, which, we believe, is of extreme importance in all cases of advanced intestinal obstruction. Following the operation a 250 c.c. transfusion was given.

We questioned the advisability of opening the colon and attempting a local removal of the growth, but since it was attached by a broad base to the mesenteric border of the colon we doubted that this could be done without seriously interfering with the local blood supply to that portion of the bowel. We also would have invited infection in case the growth could not have been removed. For these reasons a resection was believed to be the rational procedure.

Following the operation the temperature was 105.4°F., pulse 170, respirations 64. The temperature remained normal after the eighth day. There was no distention or nausea, and the bowels moved on the fourth postoperative day.

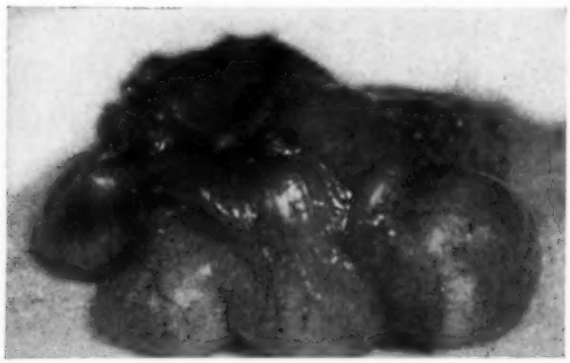

Fig. 2. Entire resected specimen. Large rounded polyp can be seen at right. Cecum has been excised directly over tumor mass and tumor has been extruded from cecum.

The enterostomy tube was removed on the tenth day, and the patient discharged on the fourteenth day.

Pathological Report (Dr. Everett Bishop): "Sections taken from the wall of the cystic mass and also from the base show large numbers of fairly normal glands of intestinal type, most of which are quite active with a fair amount of mucus, a stroma which is moderately dense and showing evidence of chronic inflammatory reaction. Diagnosis: Cystic adenomatous polyp."

Follow up Note. Six months postoperative, the patient was eating a soft diet without difficulty and her bowels were regular.

CONCLUSIONS

We believe that this is the youngest case on record of a recurrent intussusception due to a solitary adenomatous cecal polyp and one of the few successful colon resections performed on a patient aged five years.

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ACUTE APPENDICITIS IN A PATIENT WITH CONGENITAL NON-DESCENT OF THE COLON

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SPRINGFIELD, O.

MANY cases of the so-called high cecum have been presented in the literature, mostly roentgenological studies, but a case with congenital non-descent, with the cecum in the left hypochondriac region and only partial development of the transverse colon, complicated by acute appendicitis, is rare and is the excuse for the publication of this case.

The patient, J. A. a female, aged fourteen years, was admitted to the Springfield City Hospital, complaining of acute pain in the lower right quadrant of the abdomen. Two days before admission, she first noticed severe pain in the right side. This pain has remained constant in the right side and has at times radiated down the right leg. She has felt nauseated but has never vomited. There has been no referred pain to the back or shoulder. The pain is described as throbbing in character, while at other time, it is described as an ache. She has been having similar pains, but not so severe, about twice a week for the past four months.

The menses are normal, and pain bears no relationship to menstrual periods. The bowels are regular.

Physical Examination. Patient is a young, white girl, well developed and nourished, lying quietly in bed and does not appear acutely ill. Head, neck, chest, lungs and heart are normal. The abdomen is tender to palpation, and acute tenderness is present in the right iliac fossa, with the greatest point of tenderness over McBurney's point. Rovsing's sign is present, and there is a marked rebound pain. There is some muscle spasm over the lower right rectus muscle.

Rectal examination shows tenderness in pelvis on moving uterus.

Temperature is 99°F., pulse 60, respirations 22.

Hb. 65, R.B.C. 3,620,000; leucocytes 21,000; neutrophiles 90 per cent; small lymphocytes 10 per cent. Urine negative.

A diagnosis of acute appendicitis was made, and the patient was operated upon at once.

Operation. A lower right rectus incision was made, and a loop of large gut presented in the wound. This was followed and was found to be redundant sigmoid extending into the pelvis; when this same loop was followed upward, it was found to extend to the left and became adherent to the left, posterior wall of the abdomen. The right iliac fossa was filled with coils of ileum, and after these were packed off to the left, the fossa was empty and the iliac vessels and psoas muscle were exposed.

The incision was enlarged upward, until the lower edge of the liver was exposed. No hepatic flexure or transverse colon was encountered, but the duodenum in its entirety was visible. The cecum and appendix were found in the left hypochondriac region to the left of the spinal column. The appendix was injected and acutely inflamed and was pointing upward toward the greater curvature of the fundus of the stomach. The cecum was normal in size, the origin of the omentum was about 3 inches long, attached to the lower border of a short transverse colon, and under the omentum was found the terminal ileum entering the colon in a vertical direction. The remnant of transverse colon had a very narrow gastrocolic omentum attached to the fundus of the stomach at the greater curvature on the right, but to the left, the greater curvature of the stomach was bare of omentum. The mesentery of the appendix was short, and the attachment of the great omentum extended around the cecum to the base of the appendix. The appendix was removed, and the left ovary was resected for a hemorrhagic cyst.

The *pathological report* showed an appendix measuring 8 × 7 cm. The surfaces are smooth and slightly injected. Cross section shows an enlarged lumen filled with fecal debris. Sections show moderate, acute inflammatory changes throughout the wall. Acute appendicitis and hemorrhagic cyst of the ovary.

EMBRYOLOGICAL CONSIDERATIONS

In the course of fetal development, the colon undergoes the following progressive changes (Huntington, Piersol, Mall):

Fig. 1. Congenital redundancy of sigmoid.

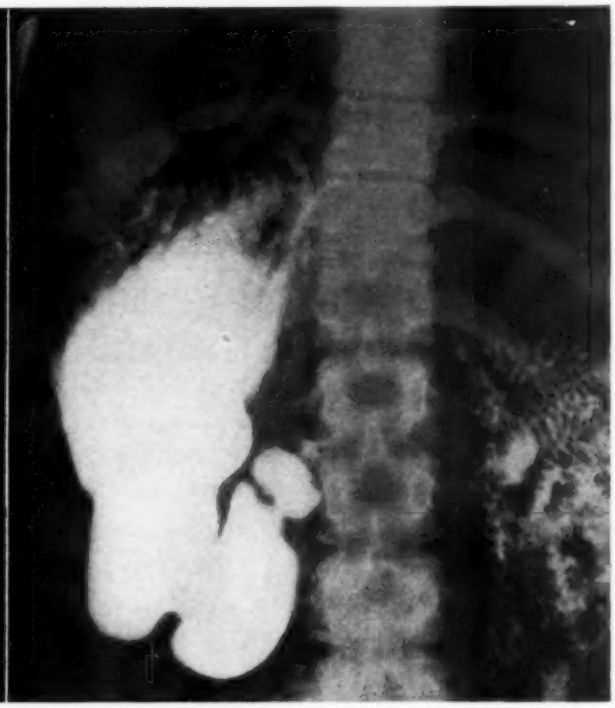

Fig. 2. Left-sided position of stomach.

The digestive tube is at first closely bound to the posterior body-wall by a short, mesoblastic band. This attachment, or primitive mesentery, from the lower end of the esophagus downward, gradually increases in its sagittal dimensions, at the expense of its breadth, in consequence of the gut-tube leaving the dorsal wall and assuming a more ventral position.

The subsequent changes which the intestinal tube exhibits during its growth, have been carefully studied by Mall. According to this investigator, the rapidly augmenting liver-mass occupies so large a portion of the still small abdominal cavity, there is no space left for the expansion of the intestinal tube. In consequence of this, the greater portion of the gut, at about five weeks of embryonic life, is displaced from the abdominal cavity into the coelom within the umbilical cord. The lower part of the body later rapidly increases in size. The intestine then returns to the abdominal cavity at about the tenth week. Mall has shown that its return occurs in a definite order; the upper part of the small intestine being first withdrawn, the large intestine with its cecal dilatation last. On re-entering the abdomen, the lower segment of the small intestine, with the cecum, takes up a position towards the right hypochondriac region near the median line, and finally reaches the subhepatic position at about the eighth month of fetal life.

Coincident with this migration, the large intestine is differentiated into a descending and a transverse colon, the former being the upper part of the vertical limb of the original dorsal flexure lying below the stomach. The cecum occupies a position under the liver, and while gradually increasing, retains this general position until adjustment in the length of the segments of the large intestine takes place shortly after birth. The lower part of the large intestine is thrown into a loop extending across the abdominal cavity, which becomes the sigmoid flexure, the latter at

birth including one-half of the entire length of the colon. After the fourth month after birth, the sigmoid flexure becomes shorter and the other parts of the colon proportionately longer, in consequence of which the cecum is pushed downward toward the right iliac fossa.

The cecum may be arrested at any part of its journey, and when at operation it is not found in the right iliac fossa, it may be looked for either in the right hypochondriac region or near the umbilicus. A muscle-splitting incision would present great difficulties in this search for an abnormally placed cecum. A number of instances are recorded of its position in these abnormal situations, the ascending colon or part of the transverse being absent. Robinson, in an analysis of autopsies of 300 male and 118 female bodies, found partial non-descent of the cecum in 7 per cent of the former and 3 per cent of the latter. Lennander mentioned the case of a boy of sixteen years, in whom the cecum and appendix were found in the left hypochondriac region lying against the spleen.

The cause of the right iliac pain and tenderness in my case is hard to explain. We know that the intestines receive their nerve supply from the superior mesenteric plexus of the sympathetic nerve through branches of the plexus which accompany the ileocolic artery. One set of branches supplies the peritoneal and muscular coats, while another set pierces these coats and supplies the blood vessels of the mucosa. When irritation to the spinal cord from the appendix is severe, overflow of this irritation may occur even into other segments of the cord, and referred pain carried by the eleventh and twelfth dorsal and first and second lumbar to the abdominal wall. Branches of the eleventh and twelfth dorsal pierce the rectus muscle to supply the skin over McBurney's point thus explaining the very great frequency of cutaneous hyperalgia at this point in acute appendicitis.

Pain and tenderness in the right iliac fossa in this case may be explained, but had the inflammatory process gone on to rupture with localized peritoneal irritation, pain and tenderness in all probability would have been present in the upper left abdomen.

CONCLUSIONS

A true congenital non-descent of the cecum, with congenital redundancy of the sigmoid complicated by acute appendicitis is presented.

An appendix abscess or rupture in this situation would have resulted disastrously.

The clinical symptoms pointed to a classical case of appendicitis situated in its normal position.

The embryonic development of the large gut can be interrupted at various stages with no impairment of health or function.

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REMOVAL OF KNIFE BLADE FROM LAMINA OF THIRD CERVICAL VERTEBRA

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THE following case is reported because of the interesting surgical problems which it presented, and because of the splendid part that nature played in transforming what could have been a most difficult surgical procedure into a rather trivial one.

CASE REPORT

At 11:00 P.M. July 18, 1931 W. B., a white male, aged sixteen entered Rush's Infirmary for suture of a laceration of the neck. This injury was sustained about thirty minutes previous during an unexpected encounter with a pocket knife.

Upon examination the patient was found to have received a 2 inch oblique laceration of the left side of the neck over the upper portion of the sternomastoid muscle. There was moderate bleeding of the wound, which appeared to involve the skin, subcutaneous fascia and extended about ½ inch into the left sternomastoid muscle. The patient held the head rotated to the right, rotation of the head in the opposite direction causing pain. The laceration was thoroughly cleansed, a debridement done and the wound closed in layers without drainage. The patient was discharged from the hospital the following morning, the head still being held in rotation to the right. Extreme soreness in the back of the neck was complained of upon attempt to rotate the head to the left. This limitation of motion at this time caused no concern as it seemed that it could be satisfactorily explained on the basis of muscle soreness.

On July 25, seven days after the injury, the wound appeared to be healing by primary intention. The deformity of the neck still remained and upon turning the face forward marked pain in the same area was still complained of. The temperature at this time was normal. The patient was advised to return to the hospital for *x*-ray study of the cervical region.

The assailant confessed at this time that during the encounter the distal end of the knife

FIG. 1. Anteroposterior plate. Blade can be seen in midline.

blade was broken off. The knife was secured and examined. The blade appeared to have been originally about 4 inches in length. Approximately ¾ inch of the blade was absent.

X-ray Examination. Anteroposterior and lateral plates of the cervical vertebrae demonstrated the presence of the broken knife blade extending transversely through the lamina of the third cervical vertebra. The point of the blade appeared to extend completely through the vertebra and was directed toward the right. The blunt or broken portion of the blade did not appear to have entered the bony structure. From the lateral plate it could be determined

that the cutting surface of the blade was directed upward and forward, being in close proximity to the spinal cord.

FIG. 2. Lateral view showing close proximity to spinal cord.

Upon readmittance to the hospital the temperature was 99°F., pulse 60, respirations 18. The following day definite signs of the presence of infection made their appearance: i.e., temperature 103.4°F., pulse 88, blood count 20,000 total leucocytes, 82 per cent polymorphonuclear leucocytes, 12 per cent small mononuclear leucocytes and 6 per cent large mononuclear leucocytes. Examination of the wound at this time showed slight swelling with some deep infiltration.

The surgical problem then presented itself: Should this patient be treated expectantly or should immediate removal of the knife blade be undertaken? To remove the blade a posterior incision suggested itself as being the most practical approach. However, because of the peculiar situation of the blade in the lamina, it was felt that the removal would be most difficult without laminectomy, the blade offering so little surface to grasp with an instrument. In face of the threatening infection and the dangerous situation of the blade, it was decided to treat the patient expectantly with cold compresses to the left side of the neck until the infection had spent its force. For the next two days the patient's condition showed no improvement. However, on July 31, thirteen days after the injury, the condition of the patient appeared to be improved. Examination of the neck revealed evidences of a deep abscess formation upon the left side apparently in the path traversed by the blade. This abscess appeared to be approaching the surface.

Operation. At 2:30 P.M. July 31, 1931, under ether anesthesia, the old knife wound was reopened. By blunt dissection the abscess cavity was opened and drained. The index finger was introduced into the cavity. A curved tunnel could be followed upward, backward and medially passing behind the transverse process of the third cervical vertebra and the examining finger could be felt to strike against the proximal portion of the knife blade. The blade protruded from the vertebra for a distance of about $\frac{1}{8}$ inch. Using the finger as a guide it was possible to grasp the protruding portion of the knife blade with an artery forceps and with a great deal of difficulty the blade was removed through the abscess cavity. The wound was left open with one drainage tube.

After the removal of the knife blade the head could be rotated beyond the midline but with slight pain. The temperature subsided gradually, the patient becoming clear of fever the fifth day postoperative. The drainage tube was shortened gradually and removed on the fourth postoperative day. Convalescence was uneventful and the patient was discharged from the hospital August 9, 1931.

THEODOR BILLROTH

[1829-1894]

THEODOR BILLROTH

THEODOR BILLROTH, probably the most outstanding surgeon of the Lister era, was born on the island of Rügen on April 26, 1829. At an early age his mother was left a widow and Theodor was one of five sons. His preference was to study music and it was only after no end of persuasion that he took up Medicine, graduating from Berlin in 1852.

After graduation he became an assistant in Langenbeck's clinic, where he attracted a great deal of scientific attention. Later, he became professor of surgery at Zurich (1860–67). From Zurich he held a like position in Vienna (1867–94). At an early date Billroth was interested in wound infections and although he went far of the mark, nevertheless he no doubt grasped the causal idea. He held that one generic group of bacteria was the cause of a host of affections.

He was an easy and prolific writer. In 1863 he wrote an excellent volume on surgical pathology and therapeutics. This was translated into nearly every modern language.

However, his great reputation was made because of his work on the surgery of the alimentary tract. He was the first visceral surgeon of his time. In 1872 he made the first resection of the esophagus; in 1881, he did the first resection of the pylorus for cancer which was successful; in 1873, he made the first complete excision of the larynx; and from 1878 to 1883, he did a large number of intestinal resections and enterorrhaphies. The world followed his lead. These operations did much to explain the pathology of intestinal diseases unknown till then. Billroth was a man of charming personality. He was genial and, we are told, a good companion. Throughout his life his great passion was music. He left some specimens of his music, also of his verse which medium he dipped into for mental relaxation. His was a life-long friendship with the great North German composer, Johannes Brahms.

A great teacher of surgery and its branches, Billroth left some brilliant and later famous pupils and assistants; the most prominent were Mikulicz, Czerny, Wölfler, Gersuny, and von Eiselsberg.

Theodor Billroth died in 1894.

T. S. W.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

SOME PSYCHOANALYTIC ASPECTS OF PLASTIC SURGERY*

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IN those persons who seek plastic surgical reconstruction for severe and demonstrable physical defects, such as scars from accidents or burns, facial deformities, birthmarks and congenital defects and the premature signs of age, the external need for the operation is so obvious that the psychological impulse urging them to it may be assumed to be entirely rational and conscious. But there are many persons who demand operations for reasons that seem to the surgeon to be vague, unconvincing or inadequate. A patient may insist, for example, on an operation for a defect that seems negligible and at the same time appear indifferent to a much more severe defect in his appearance. Or he may conceal his real reasons for seeking the operation and try to deceive the surgeon. More often he does not know, himself, why the operation seems so imperative and necessary to him.

It is apparent in such people that the wish for the operation is motivated, in part at least, by obscure causes and that the success of the operation, therefore, depends largely upon how it ministers to these hidden needs. The plastic surgeon must take into consideration the unexpressed and often unacknowledged hopes and wishes of the patient and ask himself two questions: What is the patient seeking in the operation, actually as well as ostensibly? and: What possibility of relief does plastic surgery offer him from the psychological as well as the physical standpoint?

The search for an adequate answer to these two questions leads the surgeon into the field of the psychiatrist. In this paper some of the psychological trends which are instrumental in leading people to submit to surgical operations, but which are not usually the reasons given in the history, are here discussed in a cooperative effort by a plastic surgeon and a psychoanalyst.

Probably there is no one who has not felt at one time or another some dissatisfaction with his personal appearance. Even the least self-conscious persons can recall moments of acute anguish in childhood or youth when they felt inferior because of their looks. Perhaps they were "kidded" about certain features by their families or playmates. Many nicknames such as "Freckles," "Squinty" (of the

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eyes), "Spider," "Fatty," "Skinny," "Floppy" (of the ears), "Buck" (of the buck teeth), "Whitey" (of the platinum blonde top), and dozens of other appellations of childhood days persist in the mind long after the physical defect upon which they were based has improved or disappeared entirely.

It should not be naively assumed, however, that the sense of inferiority associated with one's personal appearance arises entirely on the basis of actual physical defects, existing either in the present or in the past, but rather that it seeks and finds justification in such defects. Thus adolescents who are self-conscious, immature and socially inadequate, are exceedingly preoccupied with their appearance, comparing themselves disadvantageously with their schoolmates and feeling that if they were as goodlooking as the others they, too, could be popular.

Most people compensate for their feelings of inferiority as they reach maturity and thus lose this undue sensitiveness about their personal appearance, but there are some persons who never cease to attribute all their ill fortune to a lack of comeliness. Thus the ambitious aspirant to the moving pictures who is unable to break in refuses to acknowledge his lack of histrionic ability and points to some minor defect in his appearance as an alibi. A number of people who visit plastic surgeons are looking for someone to confirm their ideas of physical inferiority so that they may have a convenient excuse for their failure in life. They do not wish treatment for then they could no longer avoid the necessity of "making good."

Many other persons, however, are willing to go to any lengths in the interest of improving their faces and their figures. Obviously we must ask ourselves why certain people are so much concerned with their looks, with making a proper impression on people, etc., than others. At the outset it would seem safe to postulate that the question of appearance has for them some special significance, some enhanced value. We know how many people, even those who do not have operations, spend immense time and labor and patience on their faces. Such individuals defend themselves by saying that it is only too obvious that some people do not give enough attention to their looks and thereby show a disregard for the aesthetic satisfaction of others. I think one can see that both things are true and proceed to look further into the real significance of physical appearance.

Without pushing the matter into the philosophical realm we can no doubt agree that the face is the chief element in the external representation of the personality. Form, figure, manner, etc., undoubtedly enter into this. In general, when we speak of recognizing a friend we mean that we remember his face.

This is only external, for what we love about our friend is not his face but his kindness to us, his wit, his intelligence, his total physical and psychological presence. To some extent, therefore, the face is the symbol for these things, for the ego and for the total personality. But why do some people feel that the symbol is more important than the thing itself and why do they seem to be more anxious to improve the appearance of the face than to develop the more important elements of the personality which the face symbolizes?

At least two reasons can be advanced for this. In the first place such an overemphasis of the symbol is characteristic of childish thinking. Children and superficial people emphasize superficial things. This is particularly apt to be the case where the beauty is only skin deep. The little girl who said, "My face is my fortune," was, to use a slang expression, quite "wise" to herself. She had nothing to offer except the superficial impression that she made. For such a person it is highly necessary to make the best of such an offer but we should not lose sight of the fact that in such a case the face is not a symbol but the one part of the personality in which the individual has self-confidence. Naturally such individuals who exalt the importance of superficial

things abhor and avoid anything that is more than superficial, make superficial contacts, superficial solutions, superficial devices, superficial friendships, superficial accomplishments.

We must ask ourselves then whether their lack of deeper and greater confidence in their intelligence, their strength, their patience, their steadfastness and other elements of the personality is objectively justified, i.e., whether they actually lack those capabilities and qualities or whether they are deceiving themselves, i.e., whether they suffer some great sense of inferiority which prevents them from having confidence in anything except their external appearance.

One can arrive at an answer to this question in three ways: by philosophical and logical deduction, by the deeper study of clinical cases, or from the impressions and conclusions of psychiatrists whose experience repeatedly encounters this problem. To conserve space and time we shall resort to the latter method. Our experience shows that without doubt both types exist: that there are people who do well to make the best of their looks for that is all they have, but on the other hand there are many others whose emphasis upon personal appearance depends upon an extreme self-admiration, and that this self-admiration depends in turn upon feelings of inferiority of great depth and strength. These feelings of inferiority relate in general to distrust of one's ability to obtain love from others and come about as a result of serious psychological wounds in the childhood period. If the child's self esteem is severely wounded at certain stages in his development the only reaction of which he is capable is to resort to an over-abundance of self-admiration which is thrown out as a protective screen, very much like the deformity that one sees on twigs and shrubs which have been stung by an insect.

And, like these herbaceous analogs, the expansive self-admiration of the wounded child which appears later as an exaggerated concern about his looks, the impression he is making, etc., is hollow and weak. It drives him to all sorts of over-emphasis in the direction of personal exploitation and exhibitionism.

The following cases were chosen by Dr. Updegraff to discuss in this paper because they seemed to illustrate this over-emphasis on superficial things. In the discussion by Dr. Menninger some of the underlying inferiority feelings and guilt feelings which motivate such persons in seeking operations are indicated.

Case 1. A society woman in the early forties had a face and breast lift operation performed by me shortly before her marriage abroad. She confided to my secretary that her friends accused her of wearing special corsets, brassieres, girdles, etc. She went through the surgical experience rather well and prided herself on her quick recovery, which I, in turn, attributed to the fact that the amount of surgery involved was not great.

On her return a year later, in discussing the experience, she told of her actions during a prenuptial dress fitting at a smart dress shop, when after leaving a group of feminine friends in the anteroom she unconsciously walked back into the room completely nude in front of all of them. The incident, she said, had been repeated since several times in a dream, differing only in that the breasts were back to their original size again. (H. L. U.)

Exhibitionism may vary all the way from actually walking naked before people, as in the case cited above, or showing their genitals to passing women as some men have been known to do—from these overt forms to much more complicated forms of exhibitionism or showing off with which we are all familiar in social life, the stage, the beach, the drawing room, etc. Such exhibitionism is always accompanied to a greater or less extent by an unconscious sense of guilt. By this we mean that the individual deep in his soul feels uncomfortable about these trick devices he uses for bolstering up his ego and he therefore feels constantly in need of some method to atone for them. In short, he feels a need of punishment which is related to his sense of guilt for showing off. Surgery is a kind of punishment which he can accept and, to make a pun, at the same time use to save his face. He can be operated upon, no one will say

this is pleasurable, and at the same time he can increase his opportunities for narcissism. One of the striking facts that we have learned in the psychoanalytic study of human beings is that the punishments they inflict upon themselves always repeat the crime. He or she punishes the face for its complicity in the forbidden indulgence in narcissism but the punishment itself only serves to increase the opportunities for this narcissism.

It is an interesting fact that the nose is the feature with which patients express the greatest dissatisfaction; in the majority of cases it is the feature which they wish improved or reconstructed. It is not strange, however, that obsessive feelings of personal dissatisfaction should focus upon the nose, in view of the fact that the nose is such a prominent feature of the face, and that it has acquired a symbolic importance as is well recognized in folklore, fairy tales, literature (Cyrano de Bergerac, Tristram Shandy, etc.), in everyday figures of speech ("Your nose knows," "She sticks her nose into other people's business," etc.) and in the conversation of psychotic patients who often show an exaggerated interest and concern about the nose. (K. A. M.)

Case II. A private school teacher of forty for some unknown reason had never married, although she had had opportunities. Her childhood sweetheart with whom she had been on terms of exhibitionistic intimacy appeared after fifteen years' absence and opportuned her to marry him. Her narcissism had found relief in masturbation. She had read somewhere that one of the results of masturbation was enlargement of the labia. The childhood sweetheart, she felt, would discover this. After an intense mental conflict she applied for plastic reconstruction of the labia. However, her original history, given under an assumed name and address, was that of intense discomfort due to the slightly enlarged labia, extreme pruritus and the fear of developing malignancy. A minor surgical removal of the "excess" tissue gave complete relief both mentally and physically. (H. L. U.)

Such a case as this lends support to the theory that the psychological root of feelings of physical inferiority is some anxiety about the genitals. To one unfamiliar with the detailed findings of psychoanalysis such a statement seems incredible because it is not at all generally recognized that patients will unconsciously make a psychological displacement of the organ of special interest. A patient of mine, an adolescent boy who had masturbated excessively, complained constantly that his hands were too small, that they looked feminine. It was not difficult to see that he was concealing even from himself that his hands were small because of masturbation and that the other participant in the crime of masturbation had also been rendered small. In other words, he felt that masturbation had destroyed his manhood, i.e., had made him feminine. Boys will often worry excessively about pimples on their faces or some other physical evidence of such a nature that, in the words of quack doctors and misguided religionists, "Everyone will know what you are doing." In all these cases, however, the idea is essentially the same as in the case of this school teacher.

The beauty of this case is that this woman makes no such neurotic disguise of her fears. She puts the guilt exactly where she thinks it belongs, namely on her genitals. Associated with this guilt is also the feeling of inferiority about her genitals. Guilt can be relieved by punishment. Consequently the surgical operation, which destroys evidence of the sin, likewise in its punitive function relieves the burden of guilt. (K. A. M.)

Case III. A male dressmaker, prematurely bald and with decidedly aesthetic individualisms, consulted me on the possibility of replacing his lost locks by plastic surgery. He brought in a friend who unbuttoned his shirt over the chest area and exposed a decidedly masculine crop of hair. The dressmaker explained that his friend thought enough of him to be willing to sacrifice even the proverbial pound of flesh from near his heart in order that a new crop of hair might be grafted onto the patient, this assuring him of renewed virility. (H. L. U.)

In this case we have evidences that the plastic surgery is sought as a means of obtaining and enhancing a lost virility, a theme which it will be observed runs throughout most of the cases here presented. It is as if the man said, "I have lost my manhood or the symbol of my manhood but I can regain it from this friend through your aid." This idea of taking hair from someone else to gain strength for oneself is not a novel or unique one. It will be remembered that Delilah, that powerful Philistine woman, captured the strength of Samson by

cutting off his hair. The symbolic value of this is that by destroying his power she gained power for herself.

We do not know enough details about the life of this man or his friend's to make further specific deductions, but the great sensitiveness of bald men, the religious rituals of shaving the hair or of letting it grow, the glorification of the beautiful hair of women, the clipping of the hair of criminals, the shaving of hair from the face in polite society, these and many other customs bear witness as to the symbolic significance of the hair. (K. A. M.)

Case IV. There is another type of patient with whom we are all familiar. A woman of thirty-seven appeared every six months in my office, coming a distance of 800 miles to be examined. Upon the first visit she gave her age as fifteen years younger than it actually was. She represented herself as well to do, giving a fictitious name and address. She said she desired a breast lift, made an appointment to go to the hospital the following day, paid the consultation fee and disappeared.

Six months later she returned, dressed in somber attire. This time she wanted some facial reconstruction besides the breast lift. She made another hospital appointment and again failed to appear. Since that time she has continued to return every six or seven months. After a number of such visits she finally confessed her true age, name and other details and admitted that confiding in a physician and discussing the situation relieved her pent-up feelings to such a degree that she did not require further treatment and that she did not believe she would ever go through with the surgical treatment which she demanded. (H. L. U.)

This woman is representative of a large group of patients who go from one physician to another relating their story and obtaining reassurance. Their anxiety seems entirely relieved by the visit and they depart without further therapy. But soon they visit another doctor, or as in the case here cited, return to the same surgeon and repeat the procedure. In some instances the patient seems entirely cured by the recital of his symptoms but the psychiatrist, who sees a great many such cases, knows that these apparent miraculous cures are temporary responses to suggestion. Many people seek out surgeons for advice, reassurance, support and punishment, because they regard the surgeon as a strong, courageous and somewhat formidable man, much as they thought of their father in childhood. In his presence their anxiety is allayed only to return later when his support is withdrawn. To such people the plastic surgeon can give temporary psychological relief without the use of his surgical skill but only deep psychoanalytic study can discover the unconscious root of the recurrent anxiety. (K. A. M.)

CONCLUSIONS

Plastic surgeons have learned from empirical experience that both objective and subjective elements enter into the motives for the surgical operation requested by the patient in widely varying proportions. The objective motives are matters for surgical judgment. The subjective motives are usually more obscure. A few representative cases from the practice of one of us have been cited and comments on the basis of psychoanalytic experience with other patients added by the other. Our object is to show that more intimate cooperation between surgeons and psychiatrists might result in better understanding of patients and consequently better clinical results.

BOOK REVIEWS

THE SCIENCE AND PRACTICE OF SURGERY. By W. H. C. Romanis, M.CH. (Cantab.) F.R.C.S. (Eng.), F.R.S. (Edin.), and Philip H. Mitchiner, M.D., M.S. (Lond.), F.R.C.S. (Eng.). Ed. 4, 2 vols. Phila., Lea & Febiger, 1933.

The authors, in a Preface to the fourth edition, apologize for this edition following so shortly after the third. They need not. In a scientific work that goes through several editions no further praise of its merits is warranted. It speaks for its own excellence. And this holds true of this work by two noted British surgeons.

Mr. Nelson has largely rewritten the chapters on diseases of the ear, nose and throat: Dr. Fildes that on radiology and radium treatment and Dr. A. F. Potter that on anesthetics. The chapters on fractures and dislocations have been brought up to date and incorporate modern methods of treatment. The sections on blood transfusion, the sympathetic nervous system, cerebral surgery, bone diseases in relation to the parathyroid gland, carcinoma of the rectum and diseases of the spleen have been revised and remodelled, while those chapters on peritonitis, varicose veins and burns and scalds contain the most modern methods of treatment.

The two volumes, with 1762 pages of text, have 752 illustrations. The index is thorough.

The volumes are clearly and beautifully written, and the subject matter thoroughly covered.

MANAGEMENT OF FRACTURES, DISLOCATIONS AND SPRAINS. By John Albert Key, M.D., and H. Earle Conwell, M.D. St. Louis, C. V. Mosby Co., 1934.

This book brilliantly combines sound orthopedic training, research and teaching with the treatment of industrial disabilities.

The style is direct and the book is easily readable. The arrangement makes the book of interest and value to student, general practitioner and surgeon. The general practitioner will find particular value in the chapters on first aid and also in the space devoted to clinical diagnosis, which is sufficiently clear to permit treatment even if *x*-rays are not available. The surgeon will be particularly interested in the wide variety of cases reviewed and the brief references and *x*-rays of extremely rare conditions.

Principles and choice of treatment are given rather than the outlining of one method alone. The importance of plaster-of-Paris immobilization is adequately stressed and combined with the work of Orr and Böhler. Autogenous methods of repair such as fascial and bone transplantation should perhaps receive greater attention than they do.

This is not just another fracture book, but a brilliant and complete treatise on fractures, dislocations and sprains.

BOOKS RECEIVED

All books received by THE AMERICAN JOURNAL OF SURGERY are listed in this column as soon as possible after their receipt and this must be considered as adequate acknowledgment. Books that the Editor considers of special interest to our readers will be reviewed in a later issue.

ANNALS OF SURGERY, GOLDEN JUBILEE YEAR. Phila., J. B. Lippincott, 1934.

BEHIND THE SCREEN. By Maurice E. Chideckel, M.D. N. Y., Amer. Med. Pub. Co., 1933.

BRISTOL MEDICO-CHIRURGICAL JOURNAL, SPRING, 1934. Bristol, J. W. Arrowsmith, 1934.

DISEASES PECULIAR TO CIVILIZED MAN. By George Crile, M.D. N. Y., Macmillan Co., 1934.

DOCTOR (THE) AND CITIZENSHIP. By Thurman D. Kitchin, M.D. Boston, Christopher Pub. House, 1934.

GELENKSTEIFEN UND GELENKPLASTIK. By Erwin Payr, M.D. Berlin, Julius Springer, 1934.

HANDBUCK DER GESAMTEN UNFALLHEILKUNDE, Vols. 2–4. Ed. by Fritz Kronig. M.D. and Georg Magnus, M.D. Stuttgart, Ferdinand Enke, 1934.

HISTORY OF CHINESE MEDICINE. By K. Chimin Wong, M.D. and Lien-Teh Wu, M.D. Tientsin, Tientsin Press, 1932.

INFANTS AND CHILDREN. By Frederic Bartlett, M.D. N. Y., Farrar & Rinehart, 1932.

INTERNATIONAL CLINICS, s. 43, vol. 4; s. 44, vol. 1. Ed. by Louis Hamman, M.D. Phila., J. B. Lippincott, 1934.

LECTURES ON THE HISTORY OF MEDICINE, MAYO CLINIC, 1926–1932. Phila., W. B. Saunders, 1933.

MATERNAL MORTALITY. By the Committee on Public Health Relations, New York Academy of Medicine. N. Y., Commonwealth Fund, 1933.

MEDICINE—A VOYAGE OF DISCOVERY. By Josef Löbel, M.D. N. Y., Farrar & Rinehart, 1934.

MODERNE (DIE) FINSENBEHANDLUNG. By Svend Lomholt, M.D. Berlin, Urban & Schwarzenberg, 1934.

NARKOSE ZU OPERATIVEN ZWECKEN. By Hans Killian, M.D. Berlin, Julius Springer, 1934.

NEUROLOGY. By Roy R. Grinker, M.D. Springfield, Ill., Chas. C. Thomas, 1934.

NEW APPROACH TO DIETETIC THERAPY. By Eugene Földes, M.D. Boston, Richard G. Badger (Gorham Press), 1933.

NOUVELLE (UNE) SYPHILIS NERVEUSE. By Paul Ravaut, M.D. Paris, Masson et Cie, 1934.

OPERATIVE SURGERY: COLON SURGERY. By Martin Kirschner, M.D. and I. S. Ravdin, M.D. Phila., J. B. Lippincott, 1934.

PARASAGETTALEN (DIE) MENINGEOME. By H. Olivecrona, M.D. Leipzig, Gerog Thieme, 1934.

PATHOLOGISCHE-ANATOMISCHEN GRUNDLAGEN DER CHIRURGIE DES REKTUMKARZINOMS. By Heinrich Westhaus, M.D. Leipzig, Georg Thieme, 1934.

RADIOLOGIC EXPLORATION OF THE MUCOSA OF THE GASTROINTESTINAL TRACT. By Cole Laboratories. St. Paul, Minn., Bruce Pub. Co., 1934.

SHORT HISTORY OF SURGERY. By Sir D'Arcy Power, M.D. London, John Bale, Sons & Danielsson, Ltd., 1933.

SINGLE WOMAN (THE). By R. L. Dickinson, M.D. and Lura Beam. Balt., Williams & Wilkins Co., 1934.

SPREAD OF TUMORS IN THE HUMAN BODY. By Rupert A. Willis, M.D. London, J. & A. Churchill, 1934.

TINY GARMENTS. By Cornelia Otis Skinner, N. Y., Farrar & Rinehart, 1932.

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